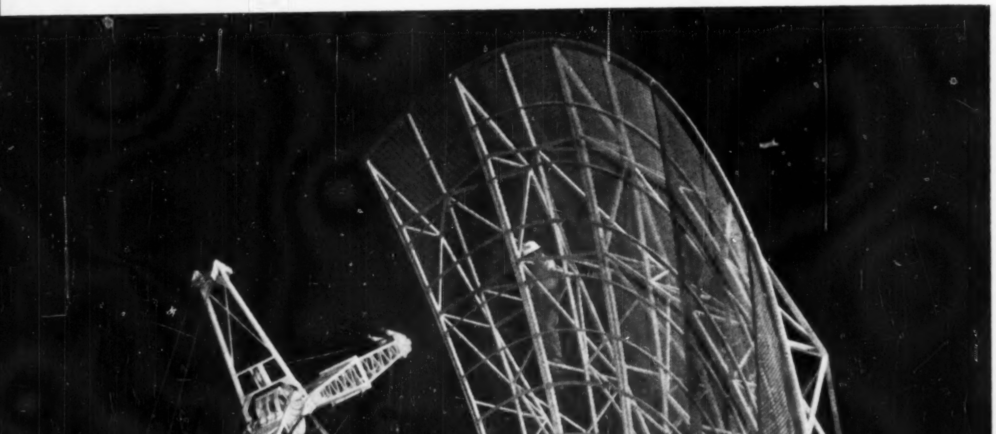
Compressed Air Magazine



JANUARY 1961

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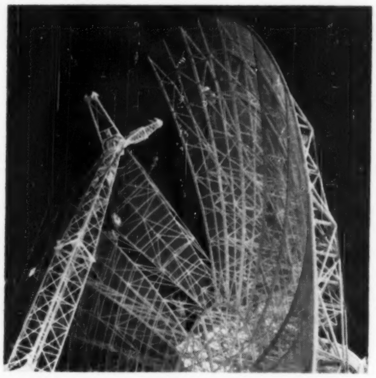

on the cover

The giant spider web being erected is a Ballistic Missile Early Warning System (BMEWS) radar tracking antenna. The pedestal stands 50 feet high, and the antenna itself is 84 feet in diameter. Though it weighs almost 375,000 pounds, the structure is precision-made and balanced. It can complete a full scan of the skies in a matter of seconds. Goodyear Aircraft contracted for three of the units with Radio Corporation of America, prime BMEWS contractor. The system should grant about 15 minutes warning of attack. Goodyear assembled the big dishes in a hanger where nonrigid airships are built.

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COMPRESSORS
PUMPS
ENGINES

FROM ONE SOURCE

...for SIMPLIFIED PROCUREMENT, OPERATION and MAINTENANCE

The Superior Oil Company chose Ingersoll-Rand for all engines, compressors and pumps at its Lowry Gasoline Plant near Lake Arthur, La.

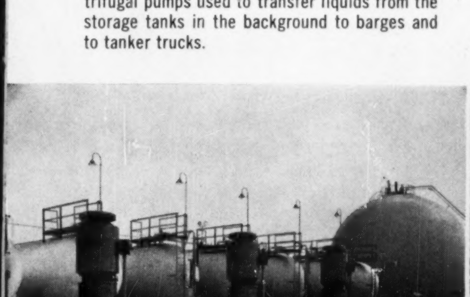
Because the Lowry plant has centralized its major mechanical equipment responsibility with I-R, it can look forward to a number of significant economies. For example, operating procedures on all engines and engine-compressors are similar, as all of them are 4-cycle V-angle units. Parts inventory may be kept to a minimum, because I-R design keeps parts interchangeability at a maximum. Maintenance procedures are standardized. And a single engineering and design philosophy developed the equipment.

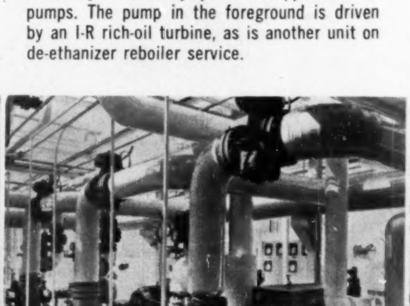
Since I-R offers (1) the most complete line of centrifugal pumps and hydraulic turbines, (2) the world's most comprehensive compressor experience, building reciprocating, centrifugal, rotary and ejector types, and (3) a century of service to the petroleum industries, you too have a good reason to choose Ingersoll-Rand. Your I-R representative can give valuable help for your problem—call him today.

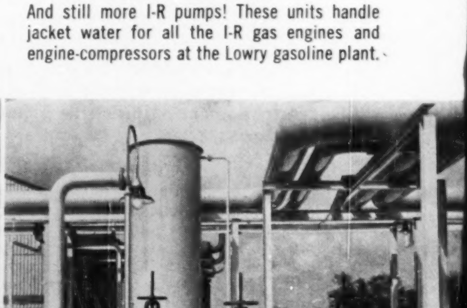
I-R PUMPS FOR LOADING
Part of a battery of Ingersoll-Rand vertical centrifugal pumps used to transfer liquids from the storage tanks in the background to barges and to tanker trucks.

I-R HYDRAULIC TURBINES DRIVING I-R PUMPS
A battery of vertically-split SJV stripper bottoms pumps. The pump in the foreground is driven by an I-R rich-oil turbine, as is another unit on de-ethanizer reboiler service.

I-R COOLING WATER PUMPS
And still more I-R pumps! These units handle jacket water for all the I-R gas engines and engine-compressors at the Lowry gasoline plant.







ELECTRIC STEEL CASTINGS

R. J. Nemmers

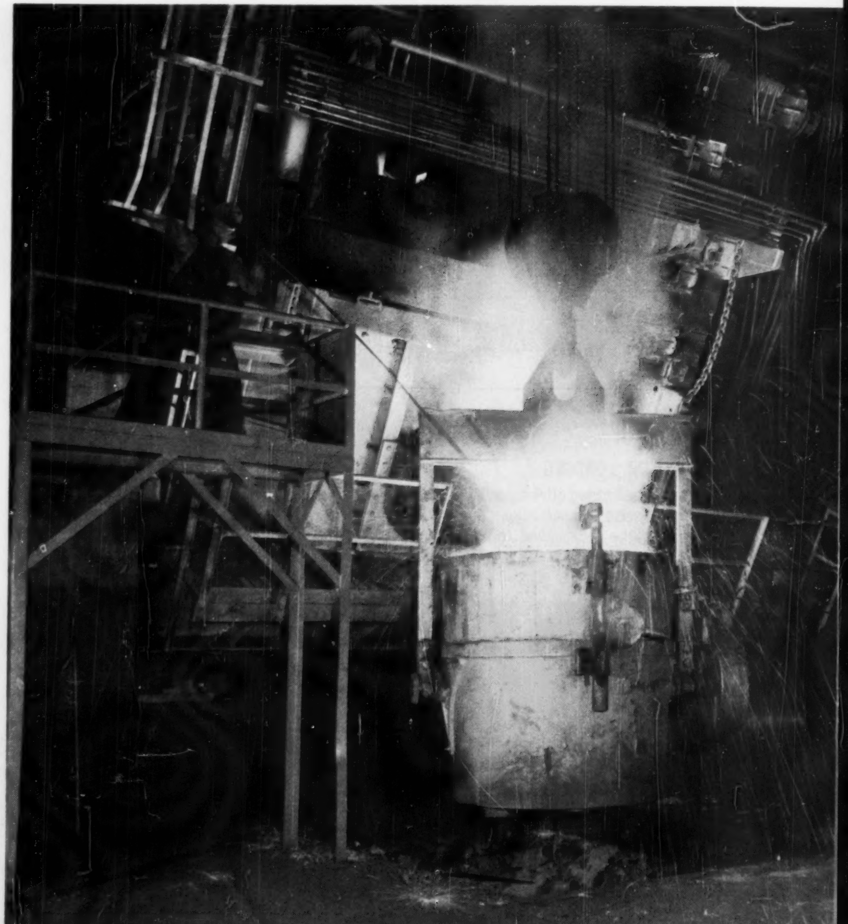
LARGE steel foundries are most frequently found in heavily industrialized and populated areas. The Eastern seaboard has many. Chicago lays claim to some of the largest of all. On the booming West Coast, many good-sized facilities are growing rapidly. All through Canada and South America, the business of making steel castings is developing some large plants. The largest, under one roof, of all electric steel foundries, however, is one set down in the lush wheat fields of eastern Kansas, far from what are generally considered to be the heavily industrialized areas of the United States.

In Atchison, about halfway between Kansas City and St. Joseph, Mo., and on the Kansas side of the muddy Missouri River, Rockwell Manufacturing Company's LFM Division has modern founding facilities with a capacity of 3000 tons of high-quality castings per month. They range from 200 to 30,000 pounds net weight. The major products are diesel locomotive and railway car frames, large high-pressure valves and structural components for heavy machinery such as rock crushers and presses and for earth-moving and oilfield drilling equipment.

The *how* and *why* of LFM's location in the Midwestern fields is a fascinating story in itself. The firm has been there for 88 years and is growing. Just last year, for example, an extensive rebuilding program was completed along with a 50-percent expansion of prior facilities. The 2-year program required the investment of some $3,000,000.

History

LFM was founded in 1872. An event to have major importance in the history of the concern took place even earlier—in 1859. It was then that the State of Kansas granted to the Atchison, Topeka & Santa Fe Railway Company a charter to construct and operate a railroad from Atchison to Topeka and "in the direction of Santa Fe, N. M." The charter lay dormant until 1871 when work was begun on what is now one of the nation's larger rail nets. (Interestingly, Atchison is no longer on the main-line Santa Fe tracks. The city, however, is served by the Chicago, Burlington & Quincy, the Missouri Pacific and the



TAPPING Three furnaces are installed at LFM—one of 24-ton-per-heat capacity at 9 tons per hour, one of 12 tons per heat at 6 tons per hour, and one of 6 tons per heat at 3 tons per hour. The largest is shown here being tapped as a workman adds aluminum to deoxidize the steel.

Chicago, Rock Island & Pacific railways.)

The year after construction of the Santa Fe started, the city fathers of Atchison offered John Seaton $10,000 to establish and operate an iron foundry there. Although its original products were such things as ornamental iron fencing, hitching posts and iron cooking utensils, the growing Santa Fe called on the establishment for many railroad requirements. Seaton soon built for his operation a solid reputation not only with the Santa Fe, but with other railroads in the area.

So rapidly did the railroad business grow that in 1905 Seaton joined two partners in the formation of Locomotive Finished Material Company. The two new associates, Harry Muchnic and Clive Hastings, brought a great deal of native engineering and business acumen with them along with growth capital. In 1914, Muchnic designed a radically new piston ring for steam locomotives. His bimetal multiple-section ring with separate internal locking spring, revolutionized the performance of steam locomotives and made LFM a dominant factor in the railway supply business, not only in the Missouri Valley, but throughout the United States. The original John Seaton Foundry Company and LFM merged that same year.

In 1930, at the beginning of the depression, the company committed itself to the construction of a new steel foundry at Atchison. It marked the major step in the shift of emphasis from gray iron to steel founding. Although most other American industries were operated at a loss, or at best were just breaking even during that period, LFM operated at a profit through the depression years. Perhaps one of the primary reasons for the success of the firm at that time was that it had always been in the vanguard of new developments. In 1924, for example, an electric-arc melting furnace was installed, both to improve the quality of iron castings and to experiment with steel castings.

Another important step in the advancement of LFM also took place at a time when economic conditions did not augur well. It was during the dark, backsliding days of 1938 that the company began experiments in the casting in steel of diesel locomotive truck frames. The initial order placed that year was for four switch-engine truck frames of a cast-weld design. Today a section of the big plant (it totals 450,000 square feet of founding and machining area under one roof), is set aside for the production of huge 1-piece locomotive and car frames.

The experience of LFM with heavy steel castings of intricate design stood the firm and the nation in good stead during World War II. Then giant machine tools were turned out to designers' specifications as part of the war mobilization program. Four of these—5-inch-bar Giddings and Lewis horizontal boring and milling machines—were installed in the LFM plant and are still in use today handling heavy machining operations on the steel castings now produced. When the nation had licked the problem of machine tool supply, LFM turned to the casting of high-pressure steam valves used on ships.

Merger

The valve work, on a contract basis for a major manufacturer, continued following the war and, although great strides were made in diversification to a wide variety of castings, the valve business remained a major line. On February 15, 1956, the company merged with Rockwell Manufacturing Company thus bringing to fruition the association with that firm's valve division. LFM now manufactures Rockwell-Hypresphere valves.

At the time of the merger, the concern changed its name to LFM Manufacturing Company, Inc. Actually the change only made official a designation by which the firm had been known for many years. In addition, getting rid of the "Locomotive" part of the name was an indication of the considerable diversification and growth of the firm away from the railroad industry. Today it still does considerable business with the railroads, but is in no way dependent on that industry's fortunes for its own well-being.

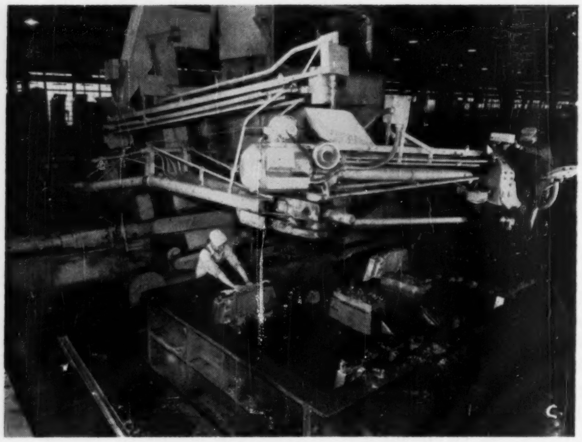
A portion of LFM, the old Berry Iron & Steel Foundry, St. Joseph, Mo., which had been purchased in 1937, is still operated as a part of the merged company.

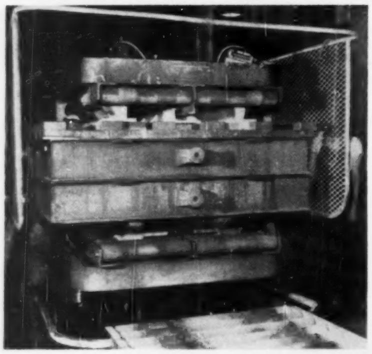
Today, LFM normally employes more than 1000 men in its Atchison facility with an additional 165 in St. Joseph. The firm's reputation for quality products and integrity is outstanding. Modern equipment and methods play an important role in that reputation, but company officials say that the skill of its workers also has a great deal to do with

(*Text continued at bottom of page 9*)

LFM'S ATCHISON, KAN., PLANT. MISSOURI RIVER IS IN FOREGROUND.

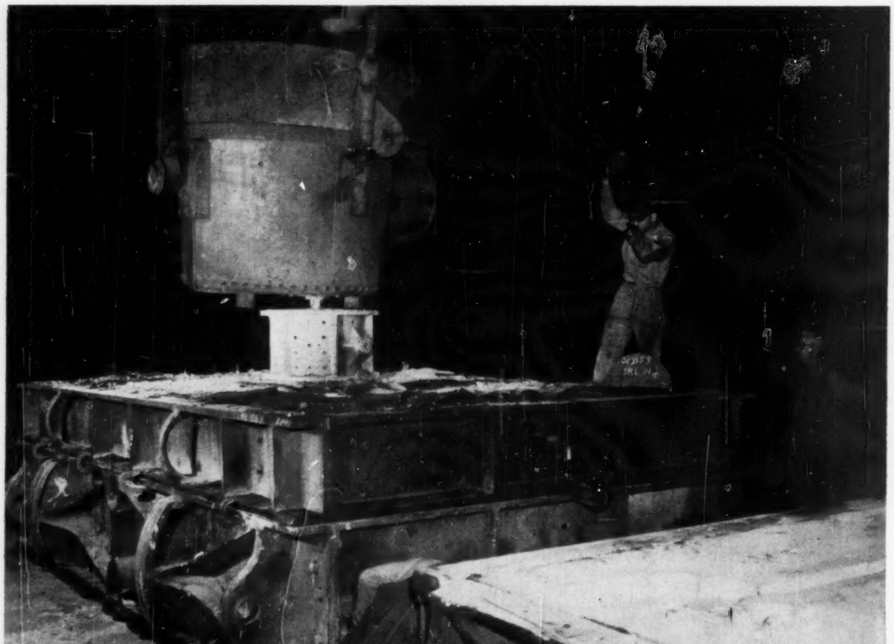
LFM Founding Practices

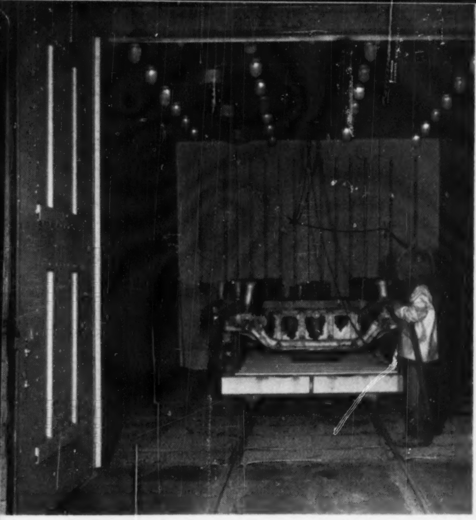


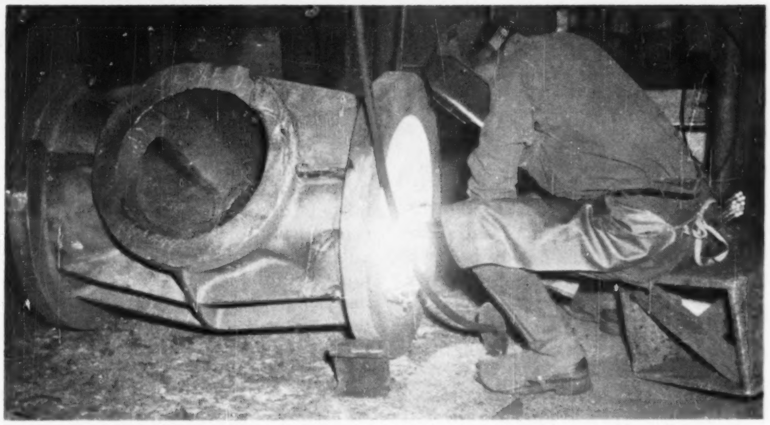


MOLDING To build up the sand molds into which the hot steel is poured, facing sand is first rammed around the pattern. Above, left, two Size 140 Bench Rammers are being used on a valve pattern. At the next station a flask will be set and rammed by a stationary Sand Slinger. Larger flasks are rammed with mobile Slingers as shown above. The pattern is for a diesel locomotive truck. Finally, flasks are fitted with a bottom board, rolled over and the patterns removed. At left is rollover machine handling smaller flasks. Air powered vibrators (visible at the top of the machine) aid in loosening the pattern from the sand as flask is lowered.

POURING Steel from one of the three electric furnaces at LFM is tapped into a bottom-pouring ladle and crane-lifted to the pouring floor. Here, as shown below, an expert workman controls the flow of the hot metal into a large flask.

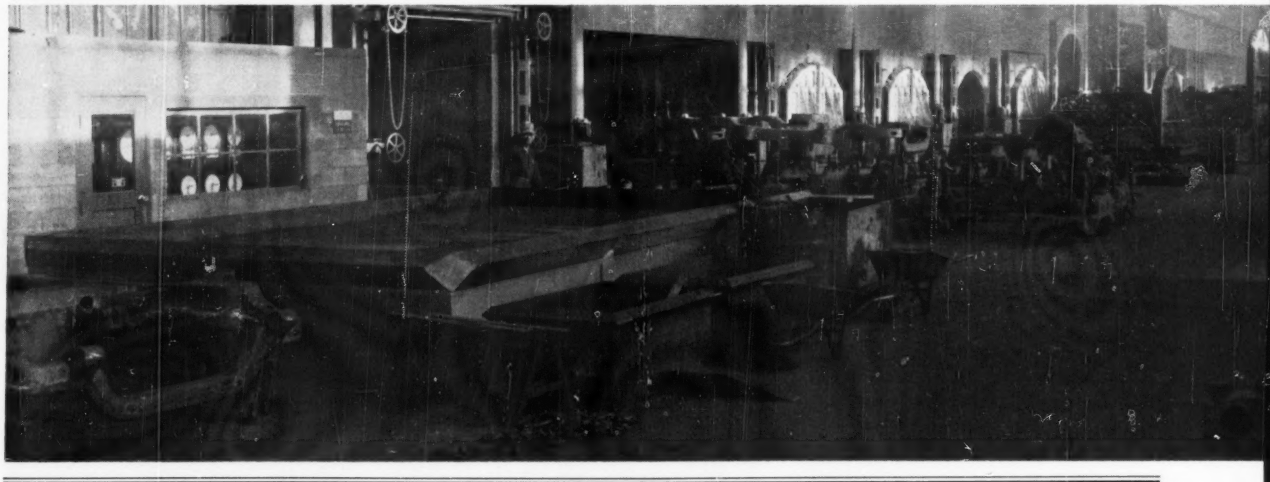






CLEAN-UP When the molten metal has set, the sand mold is shaken out of the casting. It is then shot-blasted (above) to remove scale before flash is removed with chipping hammers as shown at right above. Then the Arc-Air process is used for gouging, fin washing and washing after riser removal. Finally, the casting is again blasted.

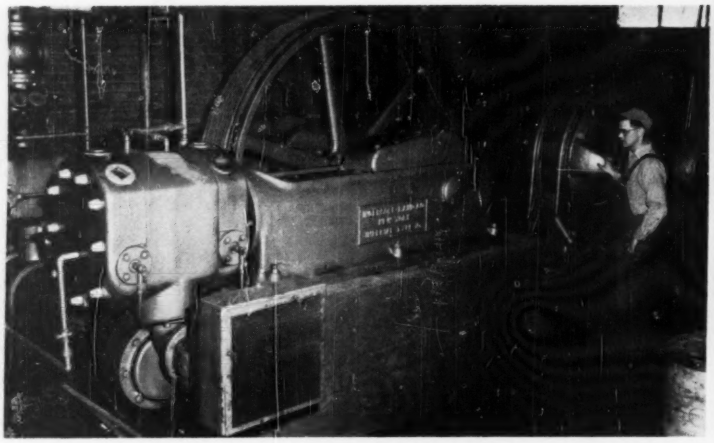
HEAT-TREAT LFM can handle full heat-treatment of all the castings produced. Below is one of two batteries of car-bottomed ovens. At left end of room is control center and a water quenching tank.

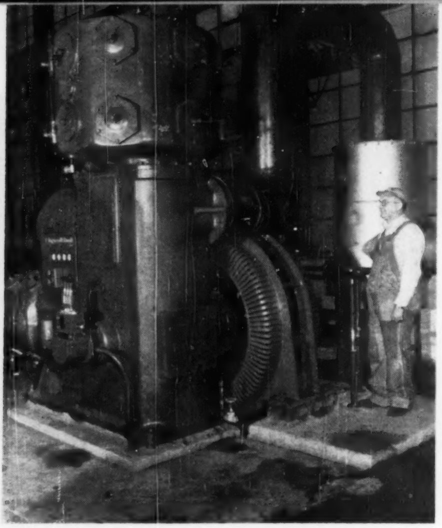


it. The training of apprentice labor has always been a carefully supervised program at LFM. As an example of the competence of the employees and their loyalty, the firm notes that in 1931 it originated and placed in production a 1-piece cast-steel cylinder for steam locomotives. A $10,000 fund was established and labeled "Reserve for Replacement of Steel Cylinders." It was intended to take care of any problems connected with the new product. The fund was never touched. Furthermore, a sizable percentage of the men then employed are still working for LFM, or worked there until retirement.

Pneumatics

Compressed air has been a part of the LFM plant almost since its earliest days as the John Seaton Foundry Company. A compressor was put in about the turn of the century and is a Rand Imperial Type 10 with mechanical Corliss valves and poppet discharge. The machine is still installed at the LFM plant but is no longer in use. A few years later, a 215-hp 2-stage PRE-type machine was added. About the time experiments with cast





COMPRESSORS LFM has a 4-compressor battery installed at the Atchison plant. The oldest and newest machines are shown above. At left is an Ingersoll-Rand Imperial Type 10 unit installed at the turn of the century. It has mechanical Corliss inlet and poppet discharge valves. It is no longer used. At right is an I-R 350-hp XLE unit that delivers 2000 cfm at a nominal 100-psig discharge pressure. Approximately 3400 cfm is available from other machines.

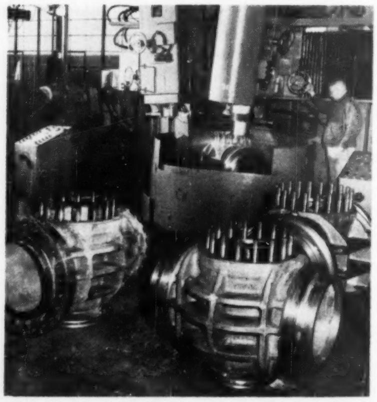
steel locomotive frames were started, another 2000-cfm unit was added to the battery of compressors.

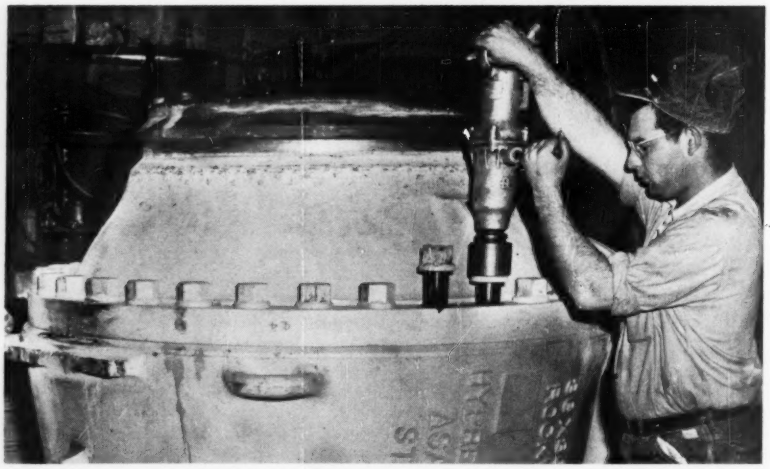
During the recently completed expansion program it was determined that additional compressor capacity was required. In the interest of obtaining a unit that did not require a massive foundation in the soft alluvial soil of the Missouri bottomland, LFM selected an "L" shaped unit with well-balanced running characteristics. The 350-hp XLE 2-stage unit occupies a comparatively small area as well. It has a length of but 10 feet 3 inches and width of 7 feet 2 inches including its crankshaft-mounted synchronous motor. The compressor is equipped with a Size 98PL-12 (pipeline type) aftercooler. It has 5-step clearance control of capacity and delivers a nominal 2000 cfm at 100 psig at full load.

Pneumatic Tools

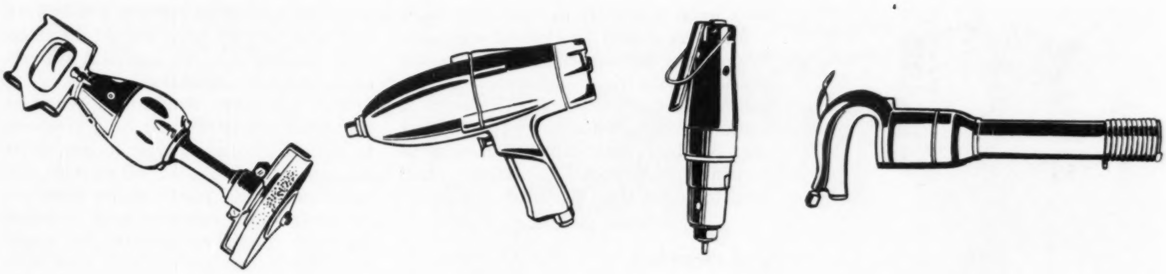
Handheld pneumatic tools were put to use in the LFM plant almost as they were introduced. Today, grinders, chippers and sand rammers are indispensable to the foundry operation. So are pneumatic hoists. The primary reasons, of course, are the oftquoted lower maintenance costs and lightweight with easy handling characteristics in the case of the tools. Easy precise control and the ability to handle overloads, even up to full stall, without damage, make the hoists popular. All the pneumatic-powered tools in the foundry, of course, are relatively unaffected by the dust and grit associated with foundry operations.

LFM is a hybrid organization in some respects. Its Hypresphere valve line indicates that it is a completely integrated manufactory. From castings, through rough and finish machining, to final assembly, these valves are complete products of the concern. Certain other items turned out by LFM represent more-or-less standard (even "off-the-shelf") products, yet are sold as component parts to other manufacturing concerns including some within the Rockwell Manufacturing Company family. Finally, the company acts as a typical job-shop foundry, producing one-of-a-kind castings to buyer specifications. The latter also may be either rough or finish machined. All of this, of course, imparts a great deal of stability to the operation of the company, yet provides considerable flexibility in the scheduling of production to meet castings buyers' requirements.





MANUFACTURING Not only does LFM produce castings to order for customers, it also operates as a complete manufacturing plant. Shown are two views of the operations dealing with Hypresphere and Hypreseal valves which are made by LFM. In the picture immediately above, an Ingersoll-Rand Size 534 Impactool is running high torque studs to secure the end bell to a Rockwell 30×30×30-inch cast steel Hypresphere valve. In the top picture, a Rockwell Hypreseal valve body is being ground on a 76-inch Bullard vertical-chucking grinder.



PERIODIC PREVENTIVE MAINTENANCE

I. General Considerations—The Air System

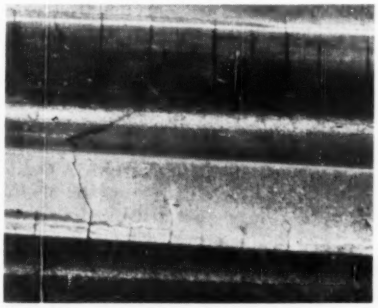
S. M. Parkhill

PNEUMATIC TOOLS, though precision machined, are designed to operate under the most adverse conditions. They can be overloaded frequently—even stalled—without harming the motor. They can be operated by relatively inexperienced men. Their advantages in wet, hazardous and dirty atmospheres have often been stated. Yet, pneumatic tools and the air system upon which they depend must be inspected regularly and properly maintained. Only then will their inherent advantages be fully realized. Only then will the tools operate throughout their natural service life at peak efficiency to gain the maximum value from the "compressed air dollar."

It is false economy to run pneumatic tools to destruction. The small businessman knows this from restricted budgets and experience. Too often, though, larger industries that utilize thousands of air-operated tools and must maintain rapidly moving production schedules feel that keeping tools on the line is more important than pulling them off for regular checking and maintenance. Nothing could be further from the truth. It has been proved that this is not economical, for simple maintenance and replacement of worn inexpensive parts can bring a tool back to its 100-percent original power and greatly extend its working life. In the over-all picture, tool replacement costs are kept at a minimum and the savings potential of air power is realized.

A leading manufacturer of pneumatic tools was questioned as to why most tools were returned for repair. The answer was a list of six basic reasons for premature tool failure. These follow, though not in order of occurrence. *First* is excess moisture from the air line. Dry air is essential. Wet air causes freezing and ice in drills and motors. In percussion-type tools, this is not quite as noticeable. But in all cases, wet air is the culprit responsible for rapid corrosive wear of parts and sticking of valves. The *second* reason for early tool malfunction is rust, scale and dirt particles entrained in the incoming air. This foreign matter comes from old hose and piping in the air system. *Third,* and related to the second reason, is that some tools are not properly equipped with air strainers at their inlet ports. *Fourth* on the list is a lack of periodic lubrication and alarmingly, in many cases, lack of any lubrication whatsoever! *Fifth* is manual abuse and misuse. The *sixth* cause of premature failure is negligence in replacing worn, inexpensive parts. Not replacing these all too frequently leads to progressive fatigue failure of the entire tool.

These six deficiencies may result initially in decreased efficiency and a sharp rise in operating costs. They may result, as in the case of grinders, in injury to the operator—a loss of man-hours and an increase in compensation payments. Finally, they may lead to the destruction of the tool itself, taking a needless bite from tool-replacement budgets.



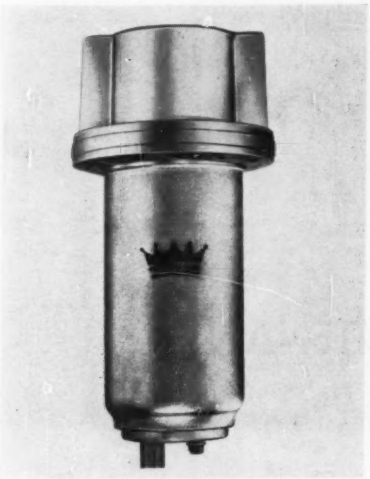
NO LUBE **The cracks in this rifle bar were caused by friction heat resulting from a lack of lubrication. Although this component is from a rock drill, the same damage can occur to pneumatic tools that are operated without lubrication.**

Air System

Three essential parts of pneumatic tools that are especially affected by rust are the throttle valve, governor valve and motor. When these parts begin to fail, lower power output and rapid wear follow. Generally speaking, wear of these parts does not lead to over-all tool destruction. However, rust on other components, if not discovered soon enough and corrective action taken immediately, does eventually mean the scrapping of the entire tool.

Basic in the service life of pneumatic tools is the air system. Aftercoolers do much to eliminate moisture from the air and rust and scale from pipes. These should be equipped with proper drainage traps—preferably automatic ones, for hand-operated traps too frequently are neglected. Air line filters, condensate traps and in-line lubricators and oilers, when properly installed also greatly relieve the first two causes of tool failure: excess moisture and foreign particles getting into the tools. Clean, moisture-free, well-lubricated air is essential for smooth, efficient tool operation and long service life.

Air line filters can be purchased in seemingly endless varieties. Some can be flushed without removing the filter element. Some come in combinations with lubricators and regulators; others can be installed as single units. In selecting the proper filters, the degree of filtration required must be considered. Screens, sintered metal, porous stone, phenolic laminates and the like are all suitable in their proper place. The filter chosen should be of ample size to prevent restriction of air flow if the maxi-



AIR LINE FILTER This self-draining filter is part of Hannifin Company's Crown line. It has a drain valve, linkage and float mounted on a removable plug that screws into the bottom of the cast aluminum bowl. The float and linkage open the drain when liquid level in the bowl reaches a predetermined height, then close the valve when the float drops to a low point during discharge of the liquid.

mum efficiency of compressed air systems is to be realized.

In general, it can be said that the filter, or filter-lubricator combination, that is most applicable to the user's specific application should be purchased. As a guide, the user can turn to the tool manufacturer's trained sales-engineers or to a reputable air accessory distributor or supplier.

Water traps in the air line will eliminate some of the work load placed on filters. They should not take the place of filters, however, for the latter are still necessary to remove the finer particles not trapped by these "water legs." Traps should be installed with attention to their placement; they should not be positioned indiscriminately if they are to be effective. Units with automatic moisture drains are always advantageous, and are required when traps are installed in locations that make hand draining impractical, or in plant installations where the air system is vast and hundreds of traps are required.

Strainers

Closely allied with the advantages of air line filters is the use of strainers furnished with a number of quality pneumatic tools. These are located at the inlet ports to prevent particles of dirt and rust that may be picked up in the air line downstream from the filters or in hose from entering the tool and causing severe abrasive wear. Bearings and motor parts are notably susceptible to such wear, especially in vane-type tools.

Strainers should be cleaned regularly. When they become clogged, the power output of the tool is sharply reduced, raising production costs. However, it cannot be stressed too strongly that after these strainers are cleaned, they must be returned to the tool. Not doing so will lead to aggravated tool wear.

Lubrication

Thousands of tools are ruined annually because they are run without lubrication. It is estimated that 50 percent of all air-operated tool failures result from faulty lubrication.

Friction resulting from a lack of oil causes the surface layers of rubbing parts to heat far beyond their normal working temperatures. This expansion tends to pull the thin outer layer of steel away from the colder metal beneath. Since the expanding metal is confined, it is often compressed until its volume, when cooled, is less than the original volume. Built-up stresses then cause cracks to appear in the metal. Intense heat also changes the density, physical and even chemical characteristics of the surface layers of the affected parts. These denser layers begin to lift away and result in checking and spalling.

Pneumatic tools must be lubricated to prevent this needless wear, however, it must not be overdone. Excess oil and grease can be almost as damaging as no lubrication. It results in overheating, causing gumming and a reduction of power output.

Some tools, such as vane-type motors, are equipped with oil reservoirs. They are, in effect, constantly lubricating themselves when this reservoir contains oil. Everytime the tool stops, air pressure in the reservoir is greater than that in the rest of the tool (it bleeds to atmosphere from the tool when the trigger is released). When restarted, a fine mist of oil flows into the tool.

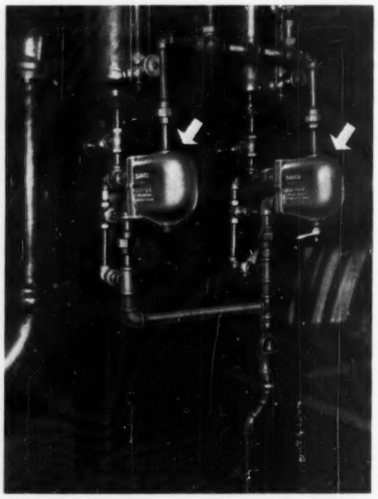
The operator should hold a paper in front of the exhausting air stream to determine whether or not the feed rate from the oil reservoir is properly adjusted. A fine spray of lube appears on the paper when the tool is in proper adjustment. If no oil appears, but the reservoir is full, or if excessive lubricant covers the paper, the air pressure flow in the reservoir should be corrected. Quality tools provide a simple means of doing this; in one case, a screw acting on felt wadding is provided for regulation.

Those tools not equipped with oil reservoirs must be lubricated by means of in-line oilers or lubricators. In fact, it is wise to always use these lube devices whether or not there is a reservoir in the tool. It is far easier to remember to fill these lubricators—although they hold a great quantity of oil—on regular inspection-maintenance routines than it is for the individual operators to be sure tool reservoirs are full. Should the reservoirs become dry, the tool will still receive its vital lubrication.

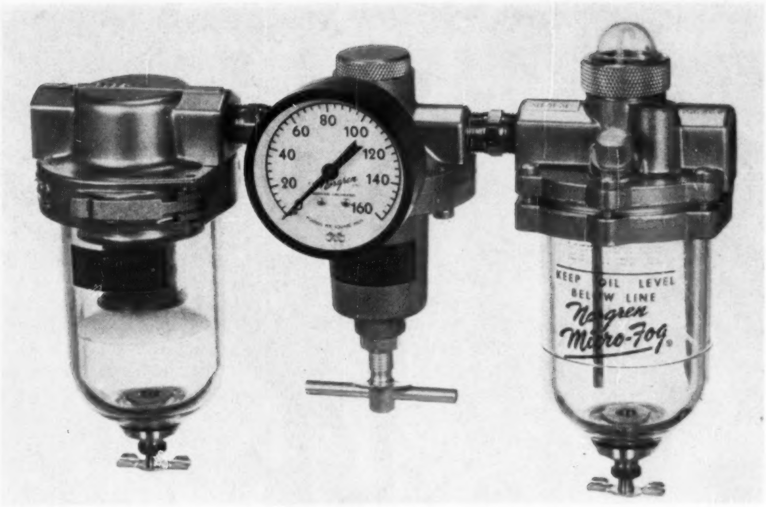
The lubricator should be located at the point where the air hose connects to the air line, or as close to this point as possible. For ease of maintaining lubricator levels, plastic dome units can be used, unless excessive heat or other inherent conditions dictate that metal bowl lubricators are needed. One oiler or air line lubricator should be used for each pneumatic tool on the line.

As with the filters and air traps, it is necessary to choose air line lubricators with care. Attention must be given to the over-all system—its function and capacity. Oilers must be selected that have a large enough capacity to do their job properly, but with a minimum pressure drop in the line. Again, the sales-engineer can help with recommendations.

Most oilers and lubricators have a means by which the amount of oil metered into the air flow can be regulated. These should be set for the correct amount of lubricant to be fed to all tools at all times. Fog-type lubricators are especially good for pneumatic tools. The finer the drops of oil that are injected into the air stream, the further they will travel. This mist does an excellent job so long as it remains a mist. However, if the fog must travel too great a distance, the oil particles tend to cling to each other forming droplets that fall to the bottom of the air line and hose, collecting in loops and at obstructions. When this happens, lubrication is not as effective as it could be. Move the oiler closer to the tool requiring lubrication.



DRAIN TRAPS Two Sarco automatic drain traps, Type FA, remove water from compressed air separators. They keep the condensate level in the trap above the valve, thus maintaining a positive seal against air leakage under all operating conditions.



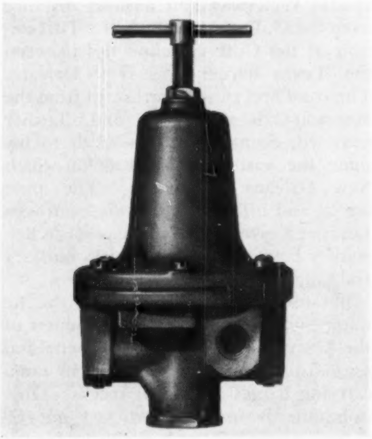
PROPER LUBRICATION A transparent bowl filter, a pressure regulator with gauge, and a transparent bowl Micro-Fog lubricator team up to provide long service life for pneumatic tools. This combination is manufactured by C. A. Norgren Company and the lubricator has a 1/2-pint capacity. The Micro-Fog principle carries a fine mist of oil to lubricate all moving tool parts.

Before discussing the fifth general cause for premature tool failure—manual abuse and misuse—it should be noted that regulators are frequently used in conjunction with lubricators, and are often found with lubricator-filter combinations. Most air systems require regulators of one sort or another. In complex setups, where there is a variety of tools and pneumatic equipment rated at different operating pressures, it is advisable to have one regulator for each working unit.

Pressure regulators allow compressed air to do a better job the most economical way. Pneumatic tools are rated for specified operating pressures. Low air pressure defeats the advantages built into them—they are like dull tools.

Gauges placed in the air line give an instant, accurate check on air pressure, graphically showing whether or not the tool is being fed air at the proper pressure to achieve peak performance.

A needle gauge is handy for checking the actual pressure at the tool when it is running. Its sharp hypodermic-type needle easily pierces hose, and when withdrawn does not leave an air leak. If air pressure is down, either from inadequate or overextended piping, leakage, or an overworked compressor system, corrective action can be taken before too many air dollars are lost.



REGULATOR The Watts regulator, Series 19, incorporates a built-in relief feature. It protects the reduced, or low-pressure line, from pressure build-up or surges by venting to atmosphere when the pressure reaches a fixed differential above the regulator setting. It also allows downward regulator adjustment without bleeding the line.

As an example of what this decreased air pressure causes, let us say one of your operators is producing 100 workpieces with a tool, rated at 90 psig but operating at 80-psig pressure. Assume the operator uses the tool 50 percent of the time—the tool use factor. If you boost the pressure to the specified 90 psig, you can get 7.8 additional units of output with the same man being paid the same wages. Should the present pressure be 70 psig, boosting it to 90 psig will give 18.5 additional units of output—again with no increase in man-hours or wages. These are figures a major tool manufacturer has arrived at and clearly point out the importance of maintaining tool power output—in this case by watching the air system.

Manual Abuse

Most pneumatic tools, by their nature and the service they must perform, are engineered and constructed to take maximum abuse. Tool manufacturers are constantly improving techniques of construction and taking advantages of advances in metallurgy to make their products ever better. Yet, pneumatic tools are needlessly abused; their service life is significantly shortened as a result.

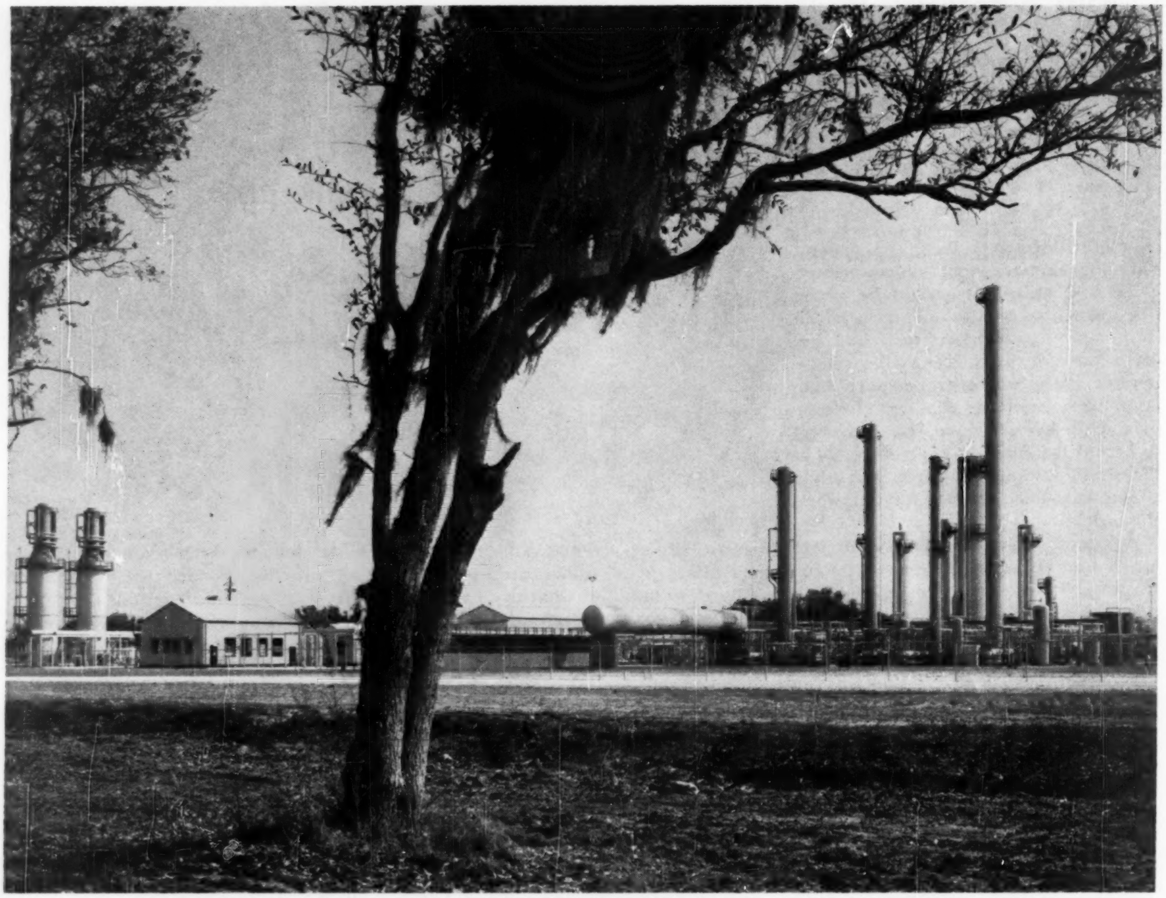
Running a tool beyond its rated limit—that is, using the improper tool for the job at hand—will cause excessive wear and result in the fatigue destruction of the tool. Underloading some types of air-operated equipment can also produce premature failure. Dropping tools damages such exposed parts as the trigger mechanism and decreases efficiency. Laying the tool on the floor puts it in a position to be run over with shop vehicles, injuring it in the same way.

Where possible, tools should be suspended from overhead balancers. These not only keep tools off the floor and promote proper use, but lessen worker fatigue—as important a factor in workpiece output per cost dollar as the efficiency of the tool itself.

Often the best way to combat misuse and abuse is to tell supervisors how harmful they can be. Men on the line have quotas to meet and cannot be bothered with the theories of pneumatic tool maintenance. They want the right tool that will do the required job each time it is used; they want a tool that will operate efficiently at all times and under all circumstances. Supervisors can watch for and correct instances of abuse on the spot. They can also indicate tools for periodic preventive maintenance.

Next month, the advantage of a program of periodic preventive inspection-maintenance, coupled with replacement of inexpensive worn parts will be outlined. In succeeding issues, planned maintenance of the three basic types of pneumatic tools—percussive, piston (overhead hoists), vane-motor—will be the subjects.

NEEDLE GAUGE Actual pressure can be checked instantly with this instrument. If air pressure is down, corrective action can be taken instantly to prevent needless loss of compressed air dollars.



TRADITIONALLY SOUTHERN, THE SPANISH-MOSS-LADEN TREE PROVIDES A NICE CONTRAST TO LOWRY'S STARK COLUMNS.

Getting Gas's Gasoline

PERSONS outside the petroleum industry are aware that natural gas and petroleum are often mentioned in the same breath but here their knowledge of the relationship usually ends. They see ignited natural gas as it flows through their stoves for cooking and they watch the gasoline pump as it pours fuel into their autos. The two energy sources seem scarcely related when put to consumer use. It would probably come as a surprise to most laymen that fully 10 percent of the gasoline produced in the U. S. is not taken from crude oil but is extracted instead from natural gas.

Breaking the gas down into its constituents (of which gasoline is only one) is not a simple process. It calls for a complex plant with highly intricate equipment. One such installation is the Lowry Gas Processing Plant of The Superior Oil Company, Cameron Parish, La. (in Louisiana a county is a "parish").

The plant is located next to the Mermentau River in extreme southern Louisiana. It is near the town of Lake Arthur, and only a mile north of the Gulf Intracoastal Waterway and a short distance from the Gulf of Mexico itself. This section of the Gulf shoreline lies between the Texas border and New Orleans. The coast arcs gently northward from the Houston-Galveston area and, farther eastward, eventually turns south to become the vast Mississippi delta which New Orleans commands. The pine forests and hills of central and southern Louisiana give way near the coast to flat, marshy lands that harbor duck, muskrat and tall cane.

Because of its proximity with the waterway, three of the four products of the Lowry plant—gasoline, propane and normal butane—are taken away by tank-carrying barges instead of trucks. Only isobutane is normally trucked out although there are such facilities for all four products.

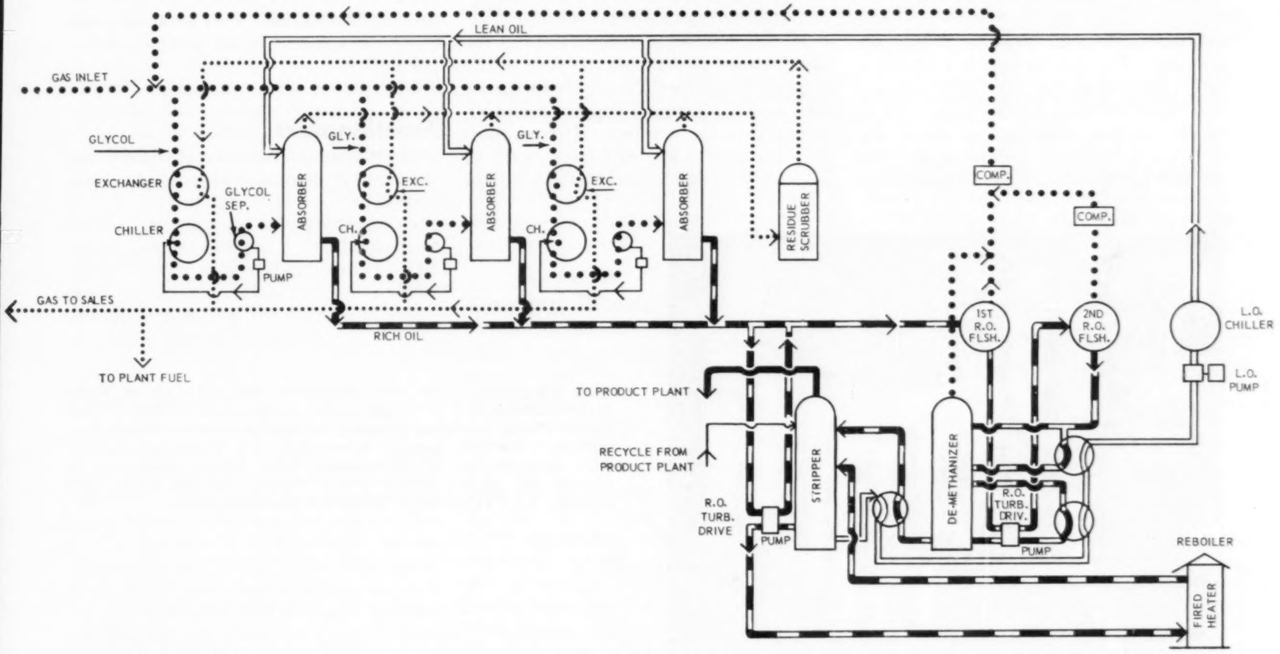
The plant, designed and built by Hudson Engineering Corporation, Houston, Tex., is one of the larger installations in southern Louisiana, and is capable of processing more than 300 million standard cubic feet of gas each 24 hours. It has several outstanding features. All

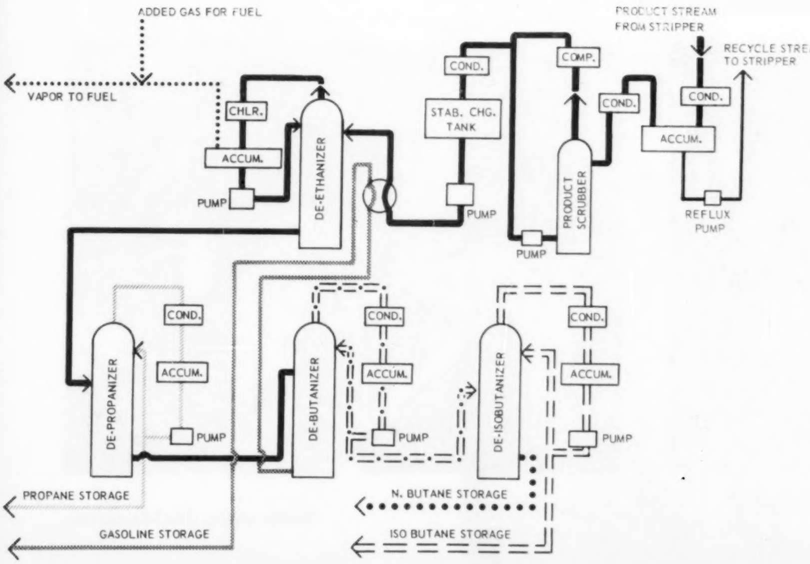
of its vessels, buildings and foundations, for example, are designed to withstand winds of 150 mph, for the area lies within the violent Gulf hurricane belt. The low elevation of the site presents a flooding problem so a dike has been built completely round the installation. Its earth walls rise 2 feet higher than the river's record level. In the past such gas processing plants often were painted a single drab color that, besides having a quietly depressing appearance, didn't make following piping systems any easier. Lowry's is pre-enameled with pastels of pink, blue, beige and yellow, and the bare piping is painted brighter colors that are attractive to look at as well as easy to distinguish. The plant has refrigerated absorption and glycol injection for dehydration. All vessels, exchangers, piping, valves and fittings that normally operate in cold service at 0° F are constructed of alloy or aluminum killed steel for possible future operation at −50° F with additional refrigeration. This feature provides flexibility for additional gas throughput, and higher recovery of propane and ethane.

Absorption and Dehydration

The plant cycle is described as follows. Natural gas, gathered from several southern Louisiana fields, enters the plant and first encounters two large separators operating at 1050 psig. After being measured, the gas from each unit flows through a common line to the absorber area. Here, for flexible operation, are three parallel banks, each containing exchangers, chillers, separators and absorbers. Any bank of the three systems can be removed from service without affecting the operation of the other two.

Glycol, an antifreeze and water absorbent, is injected into the gas as it enters the exchangers and chillers. The glycol is then removed in separators where part of it is recycled back into the exchangers and chillers. A small slipstream is bled to a unit where the glycol is reconcentrated and a small stream pumped back to the inlet of the exchangers. After the gas leaves the glycol separators, it enters the bottoms of three absorbers where it contacts cold lean absorption oil. The oil is a light naptha with a 300° to 400° F boiling range and a molecular weight of 140. The stripped gas from the top of the absorbers then flows through the inlet gas exchangers and is distributed to market at about 1000 psig.





These two diagrams schematically depict flow through the Lowry Plant. The upper, larger drawing shows the components that remove products from natural gas before the gas is passed on to sales. Note the two rich-oil hydraulic turbines. The lower drawing illustrates the separation of the four product streams, one of which is gasoline.

Absorption Oil System

The rich oil at about 900 psig from the bottom of the three absorbers is flashed through two stages to about 235 psig. Vapors from these flashes are recompressed back into the inlet gas stream. Instead of being wasted, the energy available in the high-pressure rich oil flows through two hydraulic turbines to drive process pumps. (Such turbines, which consist essentially of a pump running backward, will be discussed in a forthcoming article in *Compressed Air Magazine.)*

One of the turbines is an Ingersoll-Rand 3CNTA-6 that develops 75 bhp to drive a 4SJV pump. The other turbine is a 3JVL producing 40 bhp for driving a 4CFLA.

A total of 115 bhp is recovered by the turbines, whose output is controlled by ranging the volume of rich oil that flows through them. In the first turbine the rich oil drops from 900-psig to 500-psig pressure. The second unit is a low-pressure type where the rich oil's pressure falls from 500 psig to 235 psig. Oil in excess of that required to drive the turbines is bypassed around them. As the rich oil flows from the 235-psig flash tank, approximately 75 percent of it goes through heat exchangers to the demethanizer; the other 25 percent bypasses the exchangers and flows to the top tray of the demethanizer as reflux. In this way the vapor leaving the demethanizer is cooled without additional refrigeration.

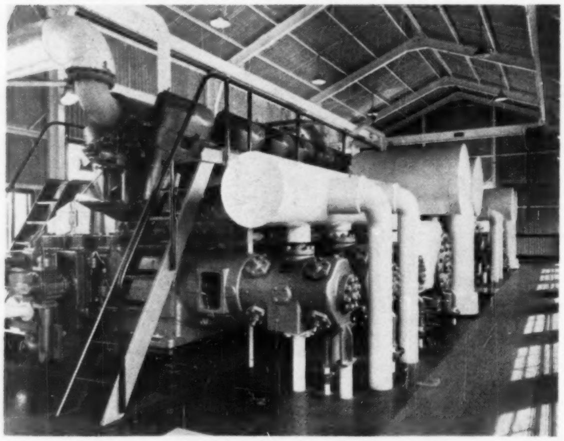
Rich oil is withdrawn from a tray near the bottom of the demethanizer. It is pumped through oil-to-oil exchangers and back into the base of the demethanizer to provide stripping vapor in the column. The demethanizer overhead effluent joins the vapor from the low-pressure rich oil flash and is recompressed back to a scrubber with the vapor from the high-pressure oil flash. The total flash vapors are then recompressed back into the incoming gas to the absorbers. Demethanized oil flows from the base of the demethanizer, through oil-to-oil exchangers, and into the stripper where the desirable hydrocarbons are distilled.

No steam is required for stripping. A large volume of oil from the base of the stripper is pumped through two direct-fired heaters, partially vaporized and returned into the stripper. These vapors strip the oil. Two oil heaters, each of 60-percent design capacity, are used for flexibility of operation, ease of maintenance, and as a provision for future expansion. Some of the oil, as it is being pumped from the stripper to the heaters, is first used as a heating medium throughout the plant. No other heat source is required. The lower 20 feet of the stripper is used as a lean oil surge tank. Lean oil from the bottom of the stripper flows through the heat exchanger to the lean oil pumps, through the lean oil chiller and then back into the absorbers.

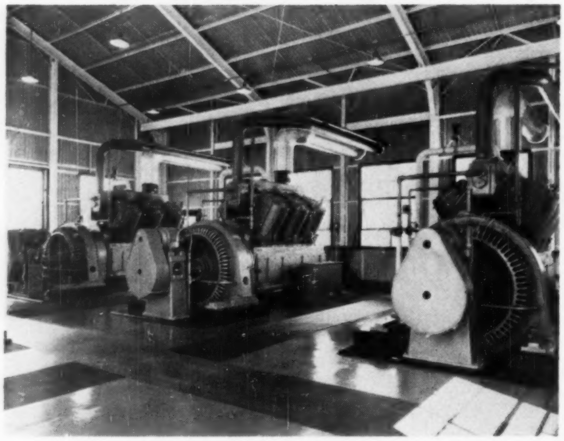
The light hydrocarbons vaporized from the oil go overhead from the stripper to reflux condensers. The noncondensed vapor and liquid in excess of that required for reflux for the stripper, flow to a product scrubber. The vapor from the scrubber is recompressed and mixed with the liquid as it is pumped through watercoolers into the raw product surge tanks at 250 psig, enough pressure for total condensation. This product surge tank has about 8 hours production capacity.

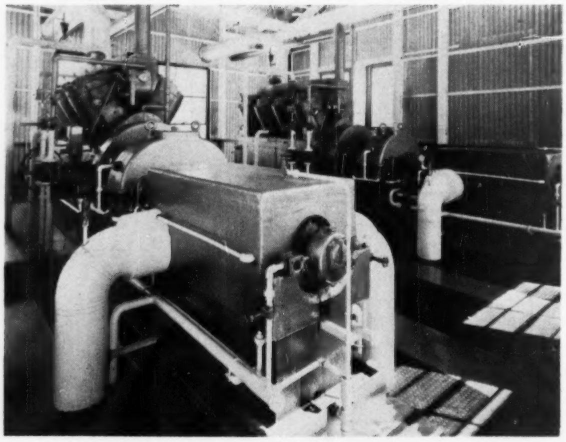
Fractionators

Four fractionators (de-ethanizer, depropanizer, de-butanizer, and de-isobu-



GAS ENGINES At the immediate left are two of three Ingersoll-Rand 512 KVG gas engine-compressors at the spotless Lowry Plant, handling propane refrigeration and recompressor services. The two pictures below show I-R PSVG gas engines. The three in the left illustration drive 300-kw generators to provide the plant's electric power supply. In the lower right picture, the PSVG's drive 4HMTA-8 lean oil pumps.





tanizer) are used to produce the four mentioned product streams—propane, isobutane, normal butane and gasoline. The raw fluid from the product surge tank is pumped through heat exchangers into the de-ethanizer. The de-ethanizer overhead goes through a refrigerated reflux condenser. All de-ethanizer overhead that is not required as liquid for reflux back in the column passes off as residue gas to the fuel system, with the necessary make-up from the high-pressure absorber residue gas.

Flows through and control of the other fractionators are conventional. De-ethanizer bottoms feed the de-propanizer. Propane goes overhead and the bottoms feed the de-butanizer. Here, both butanes come off overhead. Gasoline moves to storage from the de-butanizer bottoms. A single de-butanizer reflux pump returns reflux to the re-butanizer. It also feeds the de-isobutanizer. Isobutane goes overhead on the de-isobutanizer and the bottoms discharge as n-butane to storage.

Provisions were made to continually replenish and recondition the lean oil to maintain the specifications. A recycle of oil from the system and a condensate stream from an outside source are fed to an oil conditioner column. The absorption oil and lighter components go overhead into the stripper. The bottoms go to storage as a light diesel oil. In this way, the heavy ends can be removed from the oil system and the volume of oil in the system can be maintained.

Compressors

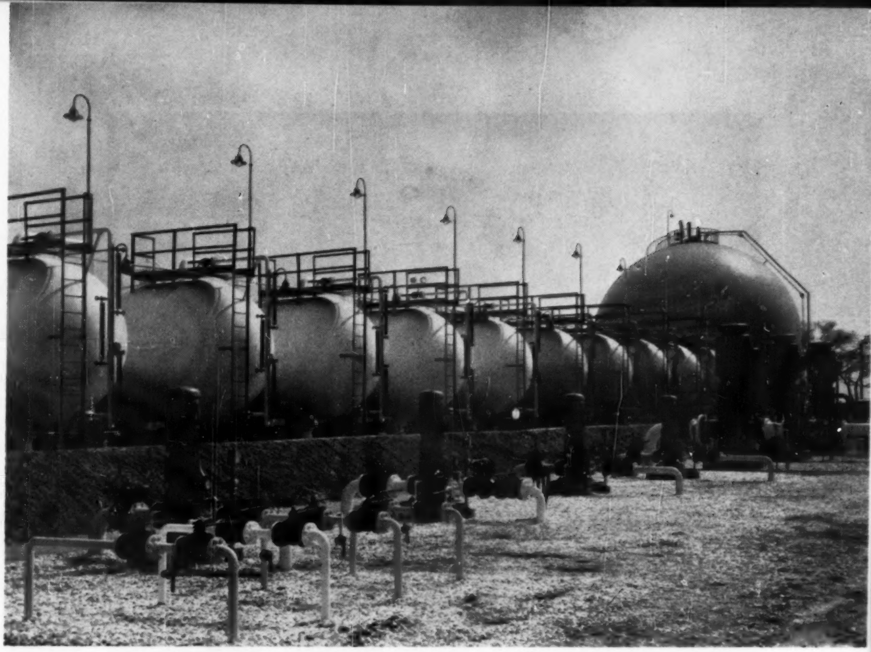
To handle the propane vapors from the refrigeration system and the vapors to be recompressed, three 1320-hp Ingersoll-Rand 512 KVG gas-engine-driven compressors were installed. Each has five compressor cylinders—two on refrigeration and three on recompression. Each engine runs independently and can be shutdown for maintenance without affecting the other two.

Lean Oil Pumps

Lean oil pumping is provided by two I-R 8-stage 4HMTA-8 centrifugal pumps. Each is powered by a 544-hp Ingersoll-Rand PSVG-8 gas engine working through a $1:7\frac{1}{2}$ gear speed increaser. Each pump has a capacity of 600 gpm at 1100-psig discharge with inlet at 7 psig. Either can circulate the design volume of oil.

Electric Power

Since all heat comes from the direct-fired heaters, no boilers were installed in the plant; gas-engine-driven generators furnish all additional power. Three 300-kw generators were installed, each driven by an Ingersoll-Rand 514-hp PSVG-6 engine (one generator is a spare). Most of the plant pumps are driven by electric motors and all pumps have stand-by spares.



TANKS These tanks store the Lowry Plant output before it is pumped aboard barges and tank trucks. The seven dark-painted Ingersoll-Rand vertical pumps in the foreground—four of one size and three of another—move the liquids.

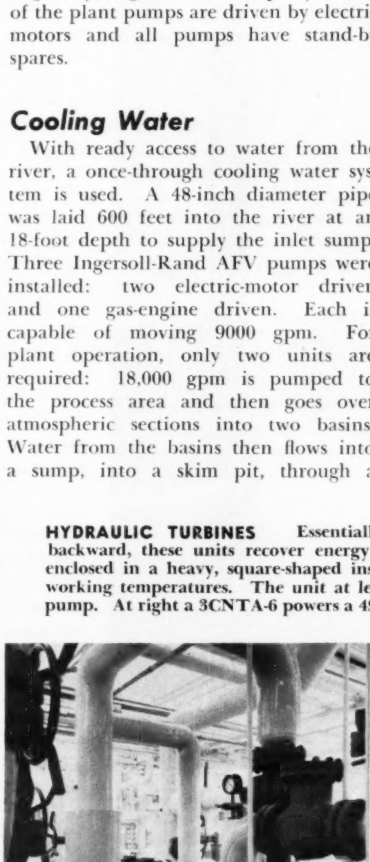
Cooling Water

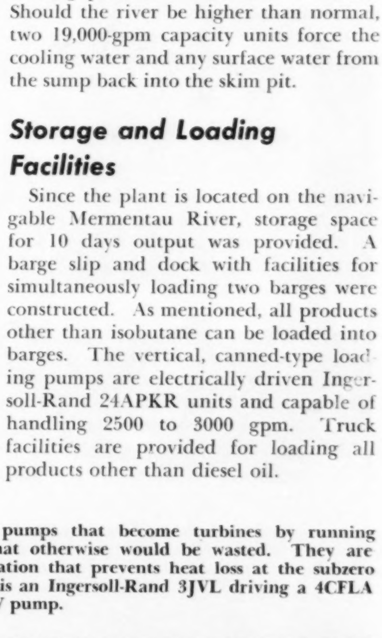
With ready access to water from the river, a once-through cooling water system is used. A 48-inch diameter pipe was laid 600 feet into the river at an 18-foot depth to supply the inlet sump. Three Ingersoll-Rand AFV pumps were installed: two electric-motor driven and one gas-engine driven. Each is capable of moving 9000 gpm. For plant operation, only two units are required: 18,000 gpm is pumped to the process area and then goes over atmospheric sections into two basins. Water from the basins then flows into a sump, into a skim pit, through a settling pond and back into the river. Should the river be higher than normal, two 19,000-gpm capacity units force the cooling water and any surface water from the sump back into the skim pit.

Storage and Loading Facilities

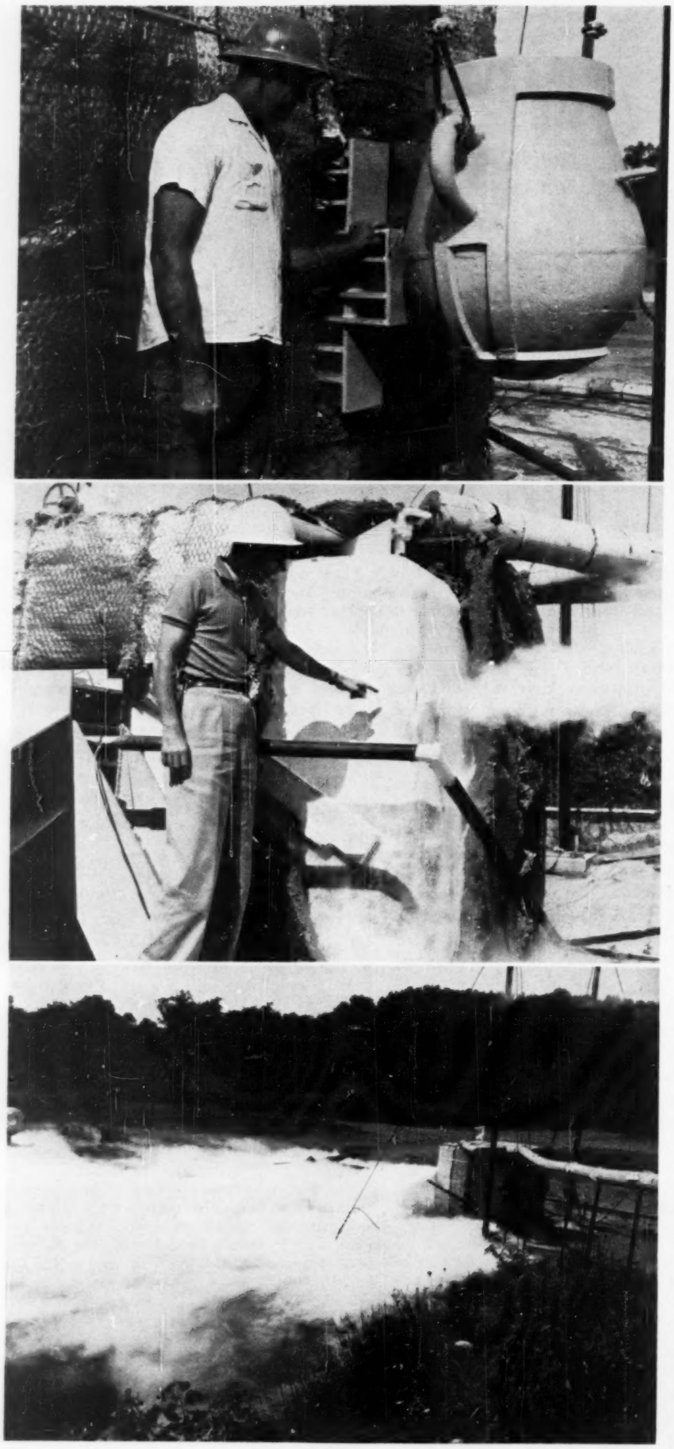
Since the plant is located on the navigable Mermentau River, storage space for 10 days output was provided. A barge slip and dock with facilities for simultaneously loading two barges were constructed. As mentioned, all products other than isobutane can be loaded into barges. The vertical, canned-type loading pumps are electrically driven Ingersoll-Rand 24APKR units and capable of handling 2500 to 3000 gpm. Truck facilities are provided for loading all products other than diesel oil.

HYDRAULIC TURBINES Essentially pumps that become turbines by running backward, these units recover energy that otherwise would be wasted. They are enclosed in a heavy, square-shaped insulation that prevents heat loss at the subzero working temperatures. The unit at left is an Ingersoll-Rand 3JVL driving a 4CFLA pump. At right a 3CNTA-6 powers a 4SJV pump.





Nine Nickel and



IMPACT TESTING These three illustrations show that phase of Operation Cryogenics in which a 4340-pound "headache pill" was impacted against a rectangular vessel filled with liquid nitrogen at −320° F. At the top the ball is shown against the vessel. Using various heights, maximum kinetic energy of the heaviest blow was more than 82,000 foot-pounds. The vessel withstood this. An engineer points to a ductile rupture (center) in the corner of a Nine Nickel vessel. The bottom picture shows final blowing after a series of crushing impacts—highly improbable service conditions.

TO SOME extent the use of the words *kryos,* cold, and *genus,* producing, has moved along with improving techniques for the "production of cold." Thus in 1821, cryophorous referred to 0° C, in 1876, cryogen referred to temperatures below 0° C. By 1908, Kamerlingh Omnes achieved a temperature of 2° K, and without a doubt, cryogenics was here. Moving back up the temperature scale somewhat to −320° F, another phase of cryogenics is upon the world. This has to do with vessels for storing liquid gases.

Tons of liquid oxygen are used to increase the efficiency of melting operations in the steel industry. Liquid oxygen applications in chemical, missile and atomic energy fields are growing. The ranks of gases that are economically and safely handled in liquefied form have swelled to include ethylene, at −155° F; methane, at −259° F; argon, −303° F; and nitrogen at −320° F.

In the natural gas industry, for example, billions of cubic feet of methane are flared off and wasted each year at oil and gas fields throughout the world. By liquefying the gas at −259° F, however, its volume can be reduced 600 times. Thus it can be easily transported in special tankers for shipment to many areas, helping to meet winter peak demands for natural gas. In some places, liquid methane may actually be less expensive than coal, fuel oil or manufactured gas. Furthermore, considerable interest has been shown about the possibility of moving liquid methane by ocean transport from Venezuelan, Algerian and Middle Eastern oil fields to European cities and possibly to seaboard communities in the U. S.

Or take as another example, oxygen. An interesting comparison of the storage economies and safety of cryogenics was made by John T. Horton of Chicago Bridge & Iron Company. He considered two ways to store 25,000,000 standard cubic feet of oxygen—a relatively small quantity. "If this amount of oxygen were stored as a gas under a pressure of 6 atmospheres (approximately 73.3 psig) one would need a spherical vessel 200 feet in diameter. Using a high-strength steel, called T-1 . . . the sphere would be about $1^1/_2$ inches thick and weigh 2000 tons. A conservative estimate of the cost of such a sphere would be in excess of $1.25 million. It must be noted that any other choice of pressure would result in nearly the same weight and cost.

"When filled with oxygen at 6 atmospheres, the sphere would also contain energy of compression in excess of 25,000,000 kilogram calories, meaning that the explosive equivalent of 15,000 pounds of TNT would be available to spread contents and projectiles about the countryside in the most improbable event of a failure.

"Compare this with a 25,000,000-standard-cubic-foot liquid oxygen container. Using the spherical shape once more for purposes of comparison, we would now have two concentric spheres, the inner one containing liquid oxygen and the outer serving as a vapor barrier and container for insulation.

Cryogenics

The inner sphere has shrunk to a diameter of 39 feet 9 inches. If made of the 9-percent nickel steel . . . it would have a maximum thickness of $^1/_4$ inch and weigh some 25 tons. An outer sphere of ordinary carbon steel 9 feet larger in diameter adds 75 tons of metal. The addition of 45 tons of insulating material brings the total weight to 145 tons. The total cost: about $100,000. Energy of compression: none, since we are now operating at essentially atmospheric pressure.

"The difference between 2000 tons at $1.25 million and 150 tons of material at $100,000 for liquid storage is too obvious. . . ."

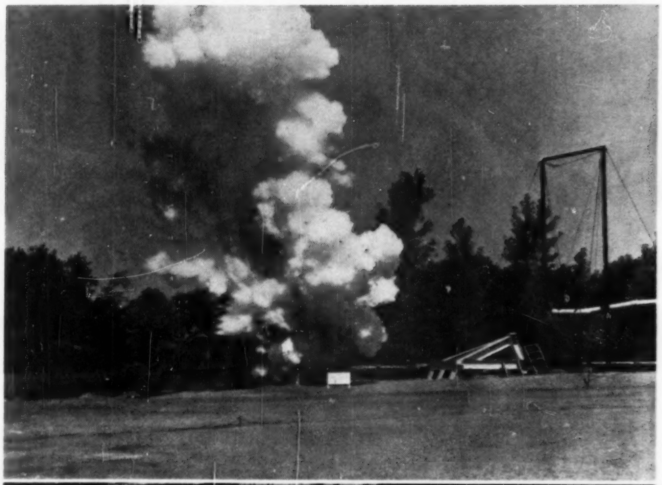
Underlying these and other cryogenic applications is a potential steel vessel market, but there are some problems. Because many construction materials become extremely brittle at supercold temperatures, vessels for these liquefied gases must not only be strong, but ductile as well. Moreover, the economics of the liquefied gas market demand that vessels must be built of a relatively low-cost material which is commercially available and readily welded.

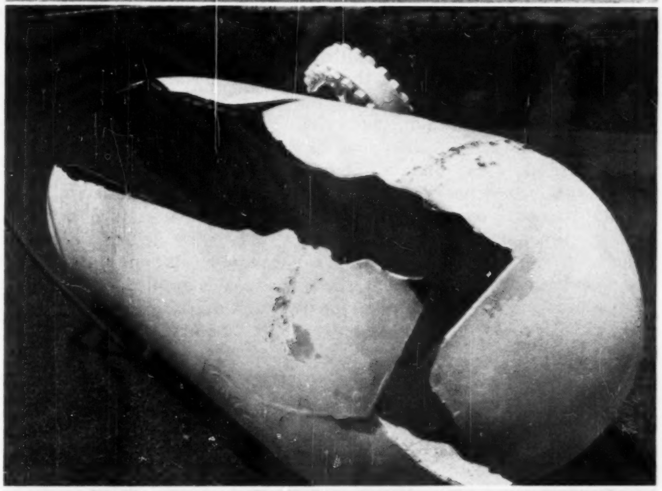
Nine-percent nickel steel seems to be the answer to this construction material problem. A joint testing program, involving U. S. Steel, Chicago Bridge & Iron Company and The International Nickel Company, has pointed out the superiority of 9-percent nickel steel.

This steel alloy was originally developed by International Nickel in 1944 at the company's Bayonne, N. J., Research Laboratory. It was found that as the nickel content of steel was increased, the transition temperature marking the range of brittle failure decreased. It was found that the so-called Nine Nickel vessels could be used for gases at −320° F with no thermal treatment after welding. Today these low-temperature-liquid containing vessels are being produced for a significantly lower cost and with great toughness.

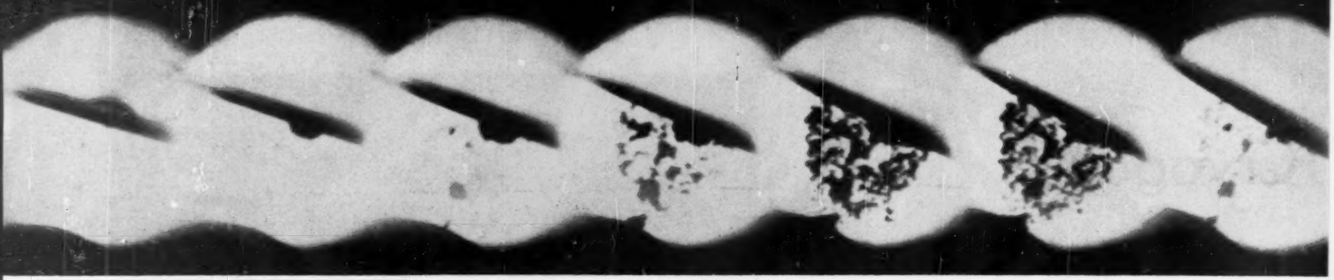
The full-scale testing program, called Operation Cryogenics, involved nine vessels of two different designs. Both groups were subjected to the severest conditions. One design (three vessels) simulated a type of rectangular container that might be used shipboard to transport liquid methane. It was filled with liquid nitrogen at −320° F and tested by the repeated crashing impacts of a 4340-pound steel wrecking ball swung against the side of the vessel from varying heights. The kinetic energy of the heaviest impact was 82,460 foot-pounds. The nickel-steel alloy vessel withstood impacts far beyond any that are likely in service conditions.

The second (cylindrical) vessels represented a type that could be used for land-based storage of liquefied gases. Each was pumped full of liquid nitrogen at −320° F until it burst from the very high internal pressure. It was found that, as expected, the pressure vessel could withstand a stress at least six times that now used in the design of low-temperature vessels fabricated from Nine Nickel. The burst pressure was 2160 psi; the burst stress 132,200 psi.





BURST TESTING At the top, a cylindrical vessel rips open, but does not shatter at −320° F under a load about six times that of the design stress. (Fragments shown are insulating material.) The center picture shows the way Nine Nickel pressure vessels rupture. The test vessel was fabricated of quenched and tempered nickel steel; it was not stress-relieved after fabrication. At bottom, an engineer inspects the fracture in a vessel of double normalized and tempered plate material; this one was stress-relieved. Both burst and impact testing showed 9-percent nickel steel vessels to be safe and economical.



Camera Captures Cavitation

CAVITATION is the hydraulic engineer's bugaboo. When fluid meets whirling impeller, bubbles often form, then disappear in a few thousandths of a second. Though short-lived, the bubbles leave their mark. They produce violent, throbbing vibration, they erode into the metal of the impeller and they rob it of its efficiency. Because of their short duration, the bubbles pose a perplexing problem to the engineer or scientist who sets out to scrutinize them.

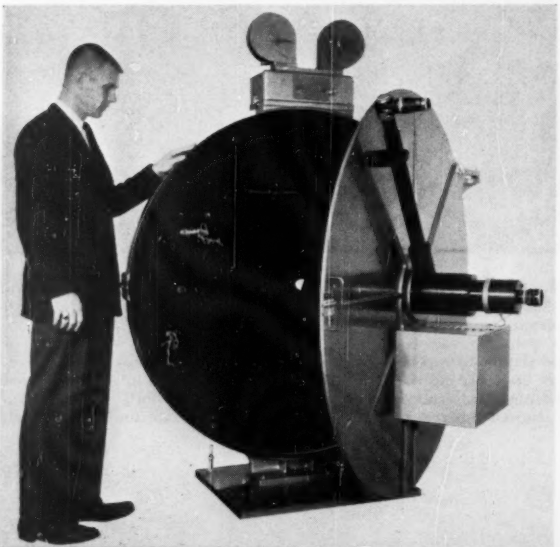
Benson-Lehner Corporation, Santa Monica, Calif., has developed a movie camera that makes possible scrutiny of the fleeting orbs of air. (The pictures across the top of the page show the rise and collapse of cavitation bubbles, caught by the camera.) The ultra high-speed unit can take from 480 to 1,600,000 pictures per second on standard black and white or color film. In effect, the camera multiplies time by as much as 100,000 times.

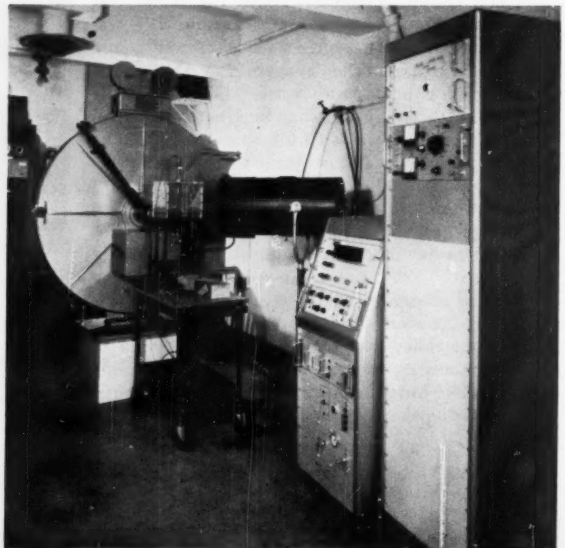
Calling the device a movie camera is taking some liberties. It is actually a combination of precision optical, electronic and mechanical components. One or two lenses focus an image on a rotating mirror inside a large disc-shaped film magazine. No mechanical shutter can attain the necessary exposure speeds so an electro-optical type is used. Light passage is controlled by ultra-rapid electric pulses. The shutter consists of two polaroid filters and a cell filled with a special substance in an electric field. When the field is not excited, no light passes. When a high-energy electric pulse is applied, the light is polarized so that it passes through the filters.

The film remains stationary while the mirror revolves at 100,000 rpm. The rotating mirror is a nickel-plated aluminum wedge attached to the staff of a high-speed, air-driven turbine. Placed at the center of the circular film box, the mirror directs the light to the film so that the image travels along the inside rim of the box. A pulser permits exposures of 0.05 to 1.0 microsecond. The film magazine has a capacity of 400 feet, and can be replenished by pushbutton without disturbing the set-up. Light comes from an electronic flash lamp that produces 400 million lumens for 3 milliseconds; this is 60 times brighter than the most powerful flash bulb.

The camera's inventor, Dr. Albert T. Ellis, of California Institute of Technology, originally designed the instrument for cavitation studies but other uses have developed. It can freeze motion to investigate arc discharges, explosive reactions, fragmentation processes and high-frequency fatigue. One field of use has been studying impact. This occurs, for example, when meteor particles bombard the skin of a space vehicle. The resulting stress waves can be made visible by bonding photoelectric materials to metal surfaces. One interesting test was photographing a rifle bullet striking a block of gelatin. This substantiated beliefs that high-speed impacts may make solids flow like viscous liquids. At slower speeds, the camera will stop the motion of cams, relays, springs, and breaker points, permitting study of stress and vibration.

ELLIS HIGH-SPEED CAMERA The left picture shows the large disc that houses film. The emulsion side faces inward along the periphery of the film box while a rotating mirror at the center projects the images outward to the film. At right, the camera is set-up to photograph cavitation in degassed water. Shown are camera, flash lamp, and control panels.





This and That

Like It's The Most (Quiet)

Beatnikwise, the coolest cat is one who emotes the least. Now, thanks to certain laboratory squares, it's possible to bang the bongos without a sound. Mylar polyester film helps make it. Two manufacturers have developed practice drum equipment using a sound-deadening material with a Mylar skin. The tough, abrasion-resistant covering provides a crisp striking surface that feels to the musician almost identical to a "live" instrument. But because of the drumhead's construction, only a whisper of a sound results from the most energetic beating. The Fips Drum Company, Inc., Westbury, Long Island, N. Y., produces a complete practice drum set. Included are bass and snare drums with large and small tom-toms, all with reversible surfaces for soft or softer-still sound control. Two "cymbal mufflers" are also available. Remo, Inc., North Hollywood, Calif., offers snare and tom-tom practice pads mounted on wooden standards. Four sizes are available, ranging from 6 to 10 inches in diameter. Now, man, you can like sit in the pad and pound the pads and not even grandmother will mind.

★ ★ ★

Oxygen In Genoa

The impact of oxygen on Italian steel production will be felt in 1961 when Cornigliano S.p.A., in historic Genoa, begins full-scale use of oxygen in its six open hearth furnaces. Air Products (Great Britain) Ltd., is building a 426-ton-per-day oxygen facility at the steel company. When completed, it will satisfy the oxygen requirement not only of Cornigliano S.p.A., but also that of the adjacent S.I.A.C. (Societa Italiana Acciaierie Cornigliano S.p.A.), also a steel-producing company. The facility will consist of two generating units. Storage for 610 tons of super-cold liquid oxygen and 910,000 cubic feet of high-pressure gaseous oxygen will also be included. Most of the plant's oxygen production will be in gaseous form, but a substantial amount of liquid oxygen (−297° F) will be produced and stored as an independent back-up supply. Nitrogen of 99-percent purity will also be turned out for annealing applications.

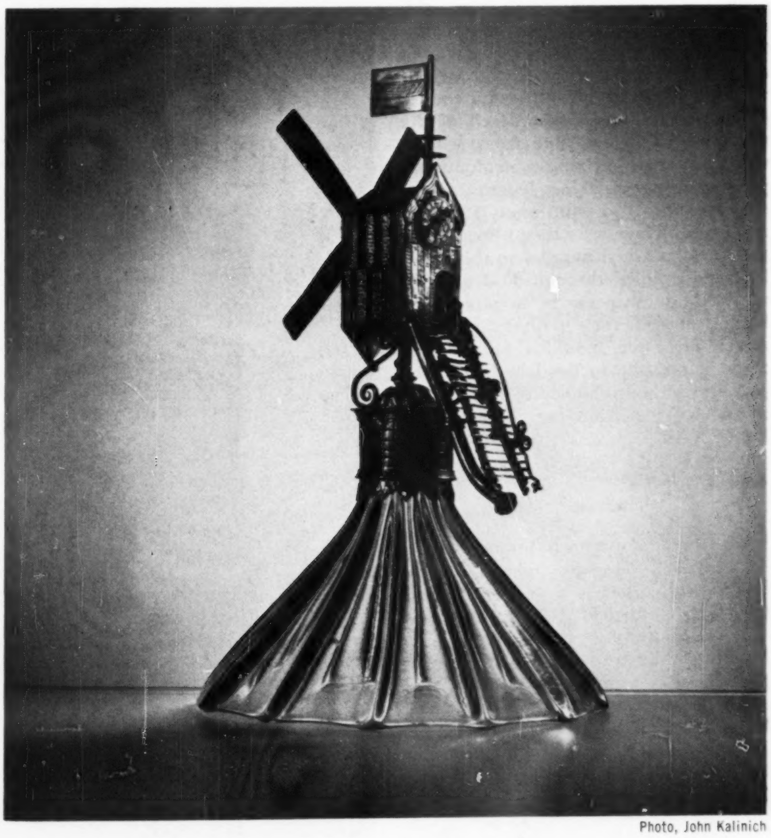
Built mostly on land reclaimed from the sea, Cornigliano S.p.A. is one of the most modern and progressive steel mills in Italy and the largest producer of flat steel products in Southern Europe. Although the company has experimented with oxygen-steel making for several years, the installation of this facility will mark the first tonnage oxygen plant built for the entire Italian steel industry.

★ ★ ★

TLC Boosts Production

Some Swedish experts have found that liberal doses of TLC (tender loving care) can do wonders with milk production. Of five pairs of twin cows, one from each pair has been placed in a large collective cowhouse where she receives perfect scientific care. The other of each pair has been entrusted to the personal care of an assistant at the Wiad Institute for Cattle Breeding, Miss Svea Jonsson. She pets them, talks to them and shows them the kind and friendly

BOTTOMS UP



Photo, John Kalinich

The wine glass shown above was fashioned by a Dutch glassmaker in the seventeenth century. It is a part of the Ruth Bryan Strauss Memorial Foundation and was exhibited at the Corning Museum of Glass in 1955. The drinking portion is the bottom half—a ribbed, conical bowl of grayish glass. This is surmounted with a silver replica of a windmill. Leading from the mill, along the staircase, is a blowing tube. By finger stopping two openings in the windmill and blowing through the tube, the vanes of the mill are set in motion. This turns the dial on the front of the mill. The number at which the arrow stops indicates the number of times the glass was to be filled and emptied. Jerome Strauss indicates that glasses of this type were probably used either ceremonially or just for convivial games during both the seventeenth and eighteenth centuries.

consideration of a small-farm wife. So far, results have been astonishing. The personally cared for cows produce up to 70 to 80 percent more milk (and never less than 40 percent more) than their sisters living in the impersonal atmosphere of the cowhouse.

★ ★ ★

Underwater Well Completion

The petroleum industry's first underwater well completion was announced early in November by Peruvian Pacific Petroleum Company. The wellhead of the pioneer project is located under 130 feet of water on the ocean floor about a mile off the coast of northern Peru. Oil now is flowing from the well to a tank farm ashore through a string of 3-inch-diameter aluminum pipes anchored to the ocean bottom. Success of the technique used could eliminate the need for costly platforms in offshore oilfield development. The unique ocean-floor well utilized a Peruvian Pacific-Richfield Oil Corporation "Christmas tree" made of aluminum piping that is expected to minimize operating and maintenance difficulties at the 130-foot depth of the wellhead. The flow line from well to shore is actually a bundle of aluminum pipes made up of 50-foot lengths welded on shore into two continuous 3250-foot segments. These were then plugged and the lines launched parallel to the shoreline and (pulled through 90 degrees of arc without the use of a pipe-laying barge) floated into position. Aluminum's favorable modulus of elasticity made it possible to bend and twist the pipeline without damaging it, according to engineers of Aluminum Company of America which supplied the pipe for the job.

★ ★ ★

Atoms In The City Of Ice

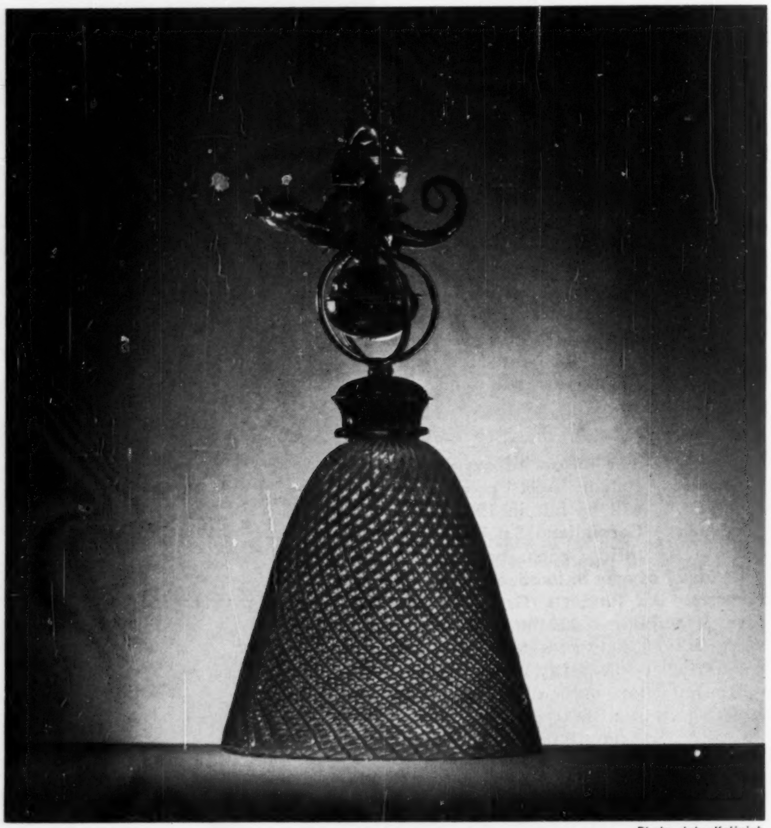
Contrary to thoughts a decade ago, the atom has proved to be more dramatically constructive than it has destructive. Nine hundred miles from the North Pole, in Greenland, a unique city is under construction. The streets of Century, as the burg is known, are being carved out of ice to a depth of 27 feet. They will then be covered with corrugated steel and a 5-foot layer of snow. Building temperatures will be maintained at 60° F; the temperature "outside" on the streets will be a maximum of 20° F. To some who are less adaptable to cold, these temperatures may seem chilly, but it must be remembered that outside the city limits where the winds often reach velocities of 185 mph and better, the temperature will dip to a severe −60° F. Century is being built for research, and the 100 men who will live there will have 200 pounds of atomic fuel—a supply that will be sufficient for 2 years. Heat, as well as power, will be furnished by a 1500-kw nuclear reactor.

★ ★ ★

Dollar Savings For Blast Furnace

A new technique in blast furnace operations resulting in sizable coke savings has been reported by The Colorado Fuel & Iron Corporation in a recent issue of *Blast*. At the company's Pueblo (Colo.) Plant, natural gas is being applied as a raw material in iron production. Its use decreases the amount of coke required to produce each ton of iron, and the value of the coke saved is much greater than the cost of the gas. Formerly, coke was the only fuel used in furnaces. It is charged with ore, and is consumed by a blast of hot air which enters the furnace through several openings (tuyeres). With the new method, natural gas is injected into the hot blast just before it passes into the furnace. The natural gas reacts with the air and coke, releasing heat and forming gases that reduce the iron from the ore. The rate of consumption of coke is slowed. By adjusting the proportion of ore and coke in the charge, it is possible to maintain the furnace operation at a lower coke rate. The magnitude of the savings might be best illustrated in terms of daily raw material usage. To produce 700 tons of iron, a furnace would have required about 550 tons of coke. By using 2,000,000 cubic feet of natural gas, it has been possible to decrease the coke usage by 100 tons per day.

FACON DE VENISE



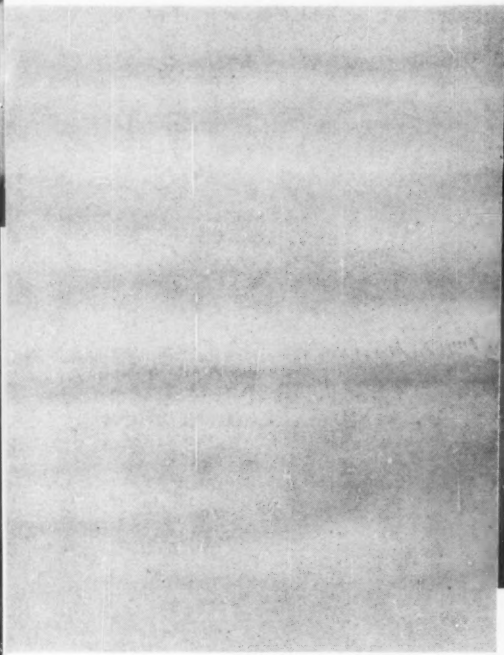
Photo, John Kalinich

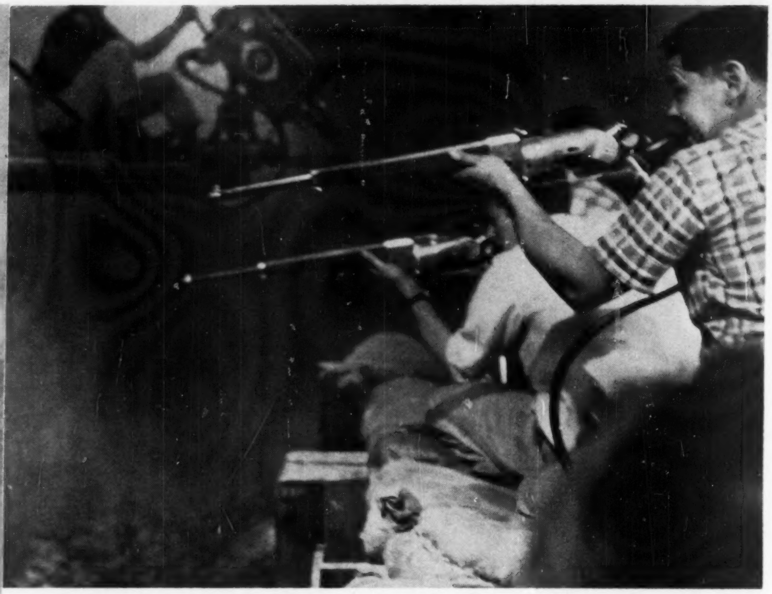
Another glass with which half the fun of drinking is promoted by air power is this goblet in the collection of the Corning Museum of Glass, Corning, N. Y. When the drinker blows into the mouth of the dragon, a shrill whistle is produced. At the same time the wheel between the wings spins. This particular goblet, which may be German, has the date 1673 engraved on the whistle. Such goblets enjoyed much popularity in the seventeenth century as a fairly large number are preserved, some with elaborate counting mechanisms that were activated when the whistle was blown for a refill. Both this glass and the Dutch wine glass illustrated on the preceding page must certainly have contributed widely to the ribaldry of ages past. Unfortunately none were seen on the first of this month.

NOT all of the weather you see on TV originates 1000 miles away in a low-pressure area and is reported to you by a pretty young woman with an armful of maps and an easy flow of meteorological terms. Indeed, many of TV's clouds begin just a couple of studios down the hall as froth from a carbon dioxide gun.

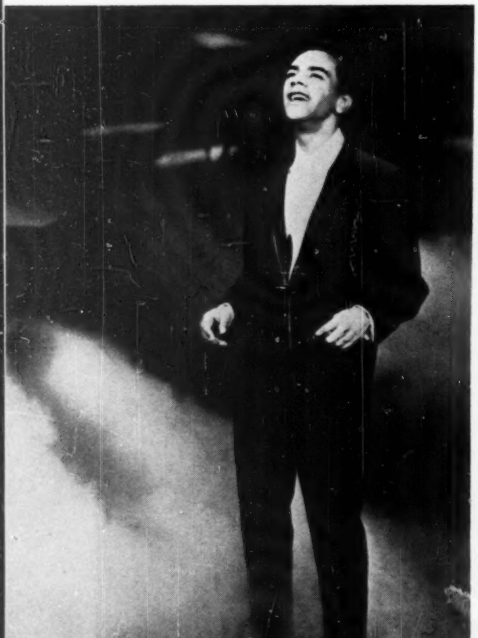
Carbon dioxide is the mainstay of the television and movie special-effects man who has to stir up a quick batch of fog. Generally used in solid ("dry ice") form, the gas is blown toward video or movie settings for many purposes. When a celluloid prison-escapee has to tramp through the inevitable swamp, carbon dioxide acts as ground fog. When a group of dancers flit through a layer of pink clouds, or when a mad scientist slinks away to his hidden laboratory, carbon

FOGGY EFFECTS **Jane Powell sings while a troupe of male dancers backs her up. The TV camera sees them all standing on clouds but backstage the view is different. Two men wield a fog gun (not visible); across stage is another.**





THAR'S ONE NOW! Television bad men scatter in droves as these silent carbon dioxide rifles riddle the plains with pellets packed with clay powder.



MISTY MATHIS Johnny Mathis, a singer of popular tunes, emotes while clouds of carbon dioxide waft about his feet. Fog was used as a romantic setting as he sang the song "Misty."

dioxide helps create, respectively, dreamy and sinister effects. Even the good guys in westerns, the bread-and-butter of TV and movieland, couldn't do in a single desperado unless carbon dioxide was there to first spatter clay bullets off the rocks dangerously near all their heads.

Temporary fog is easily created by flowing live steam over stacks of dry ice, or by simply letting the cakes sublimate and directing the soup with fans. Some scripts, however, demand that a "heavy" or more permanent fog be present. This means a fog gun is needed. A hose is run to a spout and a wire basket wrapped around the front of the spout barrel. Crystal oil, a light substance similar to mineral oil, is run into the gun through the hose and shot out in a light spray under pressure. The wire basket has been filled with dry ice so that when the oil and the carbon dioxide mix, they produce a thick, long-lasting fog.

Although occasionally a shift in wind direction, a misplaced fan or merely too much dry ice will cause the fog to rise and becloud actors, normally the heavier-than-air gas stays at knee level where it is wanted. According to Cardox Division of Chemetron Corporation, a company that supplies carbon dioxide, it is not unusual for a studio to use a thousand pounds of dry ice a day during the filming of a picture demanding heavy banks of fog or clouds.

Shooting to Miss

The realistic puffs of dust that sprout when a bullet hits the ground or rocks are fired by carbon dioxide guns. Plastic pellets filled with powdered clay are shot from the rifles by experts who know just when the hero will duck. The guns, like the fog fans, are silent so they won't spoil sound tracks.

Two specific examples of compressed carbon dioxide's use in television occurred during a Playhouse 90 program entitled "Old Man," starring Sterling Hayden. Hayden was literally shrouded in CO_2 fog for 40 percent of the drama. Portraying a convict, he was shown running through knee-deep water to escape machine gun fire. Bullets splashing in the water around his legs actually were ball bearings spat from a special carbon dioxide gun. The bearings or plastic pellets can be fired at slower and safer speeds than actual firearms' bullets.

Fighting Fire

One of CO_2's most common uses, of course, is for fighting fire. Tanks of the gas are kept on hand in studios because of the combustible nature of spindly sets and because hot lights are needed during much TV and motion picture photography. This fire-snuffing property has a unique application during shooting of some movies. It seems the proper photographing of a burning building requires many retakes. The structure must be shot from many angles and often the correct effects are not achieved with the initial filmings. Because rebuilding a house that has burned takes too much time, a pipe network is built under the doomed dwelling. Butane is fed through the piping, ignited and the building crackles for a short while, then carbon dioxide extinguishers put out the fire so that it can be kindled again later.

EDITORIAL

PLANNING FOR PROFIT

ONE OF the basic principles of cost accounting as applied to a tool of production is that its cost equals investment, plus installation charges, plus maintenance, plus production losses caused by equipment down time.

That the four items are interdependent is obvious. The old adage of getting exactly what you pay for is applicable both to new equipment and its installation. Production losses from down time are tied closely to maintenance charges, and these in turn depend a lot on the original investment in the tool and the methods by which it was installed.

The secret of successful production-tool management is the so-called "optimization of all cost factors" which is gobbledygook for making sure that the tools make the most profit for the money put into them.

All of these things, of course, are not really new to management, but there still exists a tendency to apply them only to large expensive machine tools. Such tools, of course, are important profit producers. In many cases, however, an equal or even greater profit potential lies in small hand-held power tools that don't receive this careful supervision. That statement is one that requires some discussion. The key to its truthfulness is the cost of labor.

To run each hand-held tool, in most cases, one man per shift is employed. One man per shift, however, may operate a whole battery of large machine tools. Thus the proportionate cost of labor in the application of the tools can quickly eat up the large difference in tool cost. A $200,000 machine tool that produces 1-percent more or 1-percent less per day because of the way in which it's maintained or installed is a source of profit or loss at today's margins. A new one can frequently return all of its cost and an added profit besides. Yet we often may pass over several hundred $200 tools that might easily gain several percentage points of production per day on the strength of well-planned maintenance and installation as well as planned retooling.

The plea here, of course, is not that the machine tool be given less attention, but that the portable hand-held tool be given its fair share.

Investment

Last month we urged that an inventory of the compressed air supply system be taken as a means of controlling production costs. Now we'd like to point out some of the advantages of advance planning in the use of portable pneumatic tools and rock drills. The first thing to examine is the reason for buying tools of any type. The average machine tool put into operation in a well-managed plant was not purchased just to broach, mill or turn metal, although that may be its job. It was bought instead to attain a higher quality of broaching, milling or turning, or lower costs, or both.

So it should be with pneumatic tools and rock drills. Any unskilled laborer can tighten a nut or screw given a big enough wrench or screwdriver. The reason that pneumatic tools should be put to use is to get a higher quality, more uniform job done more quickly and at lower unit cost. Thus the request for a tool purchase should not read, "We want a power wrench to tighten this nut;" it should specify "a power wrench that will tighten this nut at the lowest unit cost (including investment, installation, maintenance and down time) and maintain the specified quality our customers demand." A rock drill should be bought not just to drill holes, but to drill them at lowest over-all costs including labor, repair and parts. The difference is fundamental, but once accepted will lead to a planned installation, maintenance and purchasing program that will result in higher profits.

Re-investment

The initial investment in a production tool is not often hard to justify. Knowing when to re-invest in a new model is considered a stickier point by many, yet it need not be difficult. Managers wise in the ways of cost control say that the same criteria for initial investment applies equally to replacement investment—will the new tool do the work better and faster than the old machine now in use and will it return sufficient profit to pay for itself and leave some left over for the business? Thinking here is not just to buy a replacement, but to buy a better tool that is more capable of making a profit than the one in use.

Installation

Many plants today subsidize employee cafeterias to make sure that the workers get a good meal at noon so that their efficiency holds up well during the day. The coffee break, presumably granted for the same reason, is practically a national institution. Yet some manufacturers have no compunctions at all about starving pneumatic tools or rock drills. Manufacturers build tools and drills to perform most efficiently at 90-psig air pressure at the tool when it is running under full load. They also build them in such a fashion that a little oil or lubricant goes a long way. But that little oil is a must.

When any pneumatic tool or rock drill is put to work it's generally considered that all that has to be done is to connect it to the air line. So much for installation *if* the air line is big enough to bring 90-psig pressure to the tool and *if* an adequate in-line oiler is installed and oil is kept in it.

Maintenance

Pneumatic powered equipment has moving parts. These parts wear in use. Nowhere does the old adage about a stitch in time apply more than to maintenance of mechanical equipment. Replacing a few worn parts in a planned preventive maintenance program can save not only later replacement of more expensive parts, it can reduce production-line down time to the minimum. How to install and what to do to pneumatic tools to keep them at top performance throughout their service life, and what is and is not economical to attempt in the way of repairs is detailed in a 5-part series of articles beginning this month. Following it will be a basic study of rock drill maintenance. They present programs readily adaptable to almost any circumstances—programs that should result in lower costs and more output per dollar invested.

Battling with a Bubble Gun

Volleys from This Improved Air Device Unlock Icy Channels and Combat Stagnation

A. H. Laurie*

IF YOU have ever lived near a quiet lake or slow-moving river, probably you have watched the build-up of ice in the late fall or early winter. One cold morning the banks are lined with a thin sheet that may melt away by noon. Eventually, a few weeks later, the sun loses its race with the ice and one bitter dawn the whole lake has a shiny covering. When the dead of winter finally arrives, the ice is several inches thick and you can drive your car on it if you want.

A massive ice formation on a lake or river is an impressive thing, and one could easily imagine that the tremendous forces at work are beyond the power of man to control. After all, what last summer would merely float a canoe can now support a tank! A closer look at what causes the freeze-up, however, shows that a delicate balance is involved.

Briefly this is what happens. When water cools in the fall it gets heavier. The cooled water at the surface sinks to the bottom and the whole lake is kept circulating, much as the fluid in a gravity-flow central heating system. This continues until all the water reaches a temperature of about 39° F. Then, instead of becoming more dense with further cooling, it becomes lighter. Convection ceases. The cold water at the surface has no alternative but to stay put and become ice.

Note that the ice forms simply because convection has ceased. All the water beneath the ice (except a thin layer in actual contact with it) is relatively warm. It is a reservoir of heat. Now, if the lake water were forced to circulate, the building up of the ice cover would be delayed and perhaps prevented all together.

Personnel of Marine Developments Ltd., Nassau, Bahamas, have made (ironically, in view of their headquarters location) a close study of ice formation and how to delay it. They have observed that to keep channels open in the winter, five things are needed.

1. Convection must be re-established after the body of water has cooled to 39° F.

BURPER **Out of its element here to be photographed, this burper usually sits on the lake floor. Compressed air is piped to the bottom of the vessel to find a water-filled chamber 2 inches in diameter by 10 inches high. After slowly evacuating the water from this chamber, the compressed air proceeds up as a large bubble. The air bubble rises in a 12-inch-diameter stack pipe, taking water up too. Water and air burst out below the surface of the lake.**

2. The warm water must be raised intact from the bottom to the surface, that is, without being cooled or diluted by mixing with layers of colder water near the surface.

3. The bottom water must be discharged at the surface in quantity, and at a velocity sufficient to insure that it is properly mixed with the surface water. Otherwise it will naturally fall to the bottom again.

4. When lifted, the bottom water, with its stored heat, must be deployed over the maximum area of channel to be kept free of ice.

5. The apparatus for this system must be durable, efficient and commercially feasible.

* Inventor of the bubble gun described here, Mr. Laurie is technical director of Marine Developments Ltd., Nassau, Bahamas.

Bubble Gun

Scientists of Marine Developments Ltd. traveled to Lake Simcoe, Ont., in the winter of 1959–60 to gather information on freezing and make initial tests on a powerful deicing instrument they had developed. That summer they went to England to evaluate the information they had gathered and to make technical improvements in their instrument. Known as a "bubble gun," the unit is actually a refined variant of an air-lift pump powered by compressed air. The air is supplied at a pressure only slightly higher than the hydrostatic pressure at the depth being worked. This means in effect that all air requirements can be met by a small compressor.

Unlike a conventional air-lift pump, the device emits large, intermittent bubbles. These are discharged at the base of the gun by a polyethylene siphon, originally developed for artificial breakwaters and known as a "burper" (described as a "jug" in "Bubbles, Breakwaters and Brasher" in the November 1959 issue of *Compressed Air Magazine*). The burper fires "bullets" of air into a stack pipe of polyethylene 12 inches in diameter. These air globules fit closely into the "gun barrel" and entrain substantial quantities of water.

Adjusted to the site depth, the length of the stack pipe (gun barrel) discharges water and air about 3 feet below the surface. The stack pipe is surmounted by a combined float and deflector, vacuum-formed from plastic sheet and filled with plastic foam. This serves both to hold the stack vertical and to deflect the water output at an easy angle across the surface. Stopping off half of the stack pipe at the top results in a stream of water from only 180 degrees of the circumference. Such a stream is designed for use along the banks of a canal so that water is dispersed into the waterway.

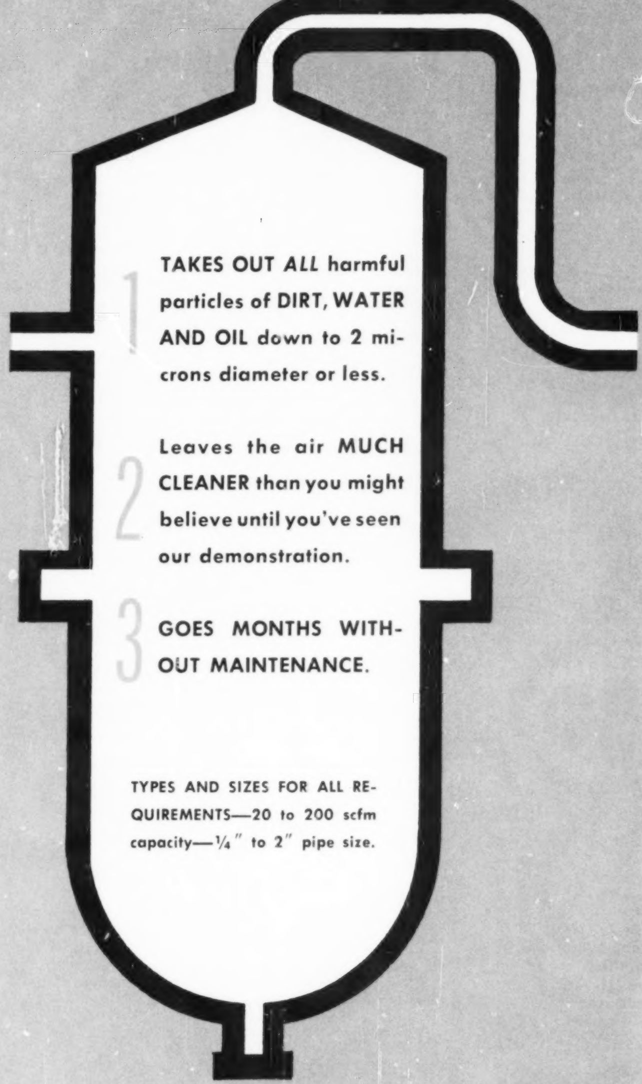
Though adjustable for position and depth, the bubble gun has no moving

(*Continued on page 29*)

NEW!

The King

COMPRESSED AIR FILTER



NEW CLEANING PRINCIPLE
is the secret.
See next page!

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(*Continued from page 26*)
operating parts and absorbs a maximum of 0.5 hp. Its mechanical efficiency comes to 85 percent. This figure may seem improbably high, but it should be remembered that the gun is not raising water above its own level; it is acting more as an extremely efficient propeller.

An input of 0.4 hp at the bottom of the gun as compressed air from a shore-based compressor moves 2,600,000 gallons per day. Performance data from the Lake Simcoe tests were correlated with heat-loss figures for water surface, provided by the National Research Council. As a result, it is estimated that in the latitude of the St. Lawrence Seaway, a channel 300 feet wide could be kept ice free all winter using a line of bubble guns on each side of the channel. Initial cost would be approximately $30,000 per mile, including compressors. The cost of operation would be approximately $750 per mile annually. Farther north the costs of such a system would increase slightly. Farther south they would be less. (Approximate figures for an ice-free channel on the Hudson River from Poughkeepsie, N. Y., to Albany, N. Y., would be $26,000 per mile of installation and an annual operation expense of $500 per mile.) An analysis of the inquiries sent to the Canadian agents for the bubble gun shows that there are varied applications for the device. Besides opening navigation channels, it could be used to prevent ice formation at wharves, locks, jetties and hydroelectric dams. Further uses have been found in England and may apply to North America. The chief one is the "destratification" of bodies of water.

Reservoir Improvement

In lakes and reservoirs during the summer, a layer of water from 25 to 40 feet deep is kept in circulation by wind action. It is fully oxygenated and hosts the great majority of the plankton and fish present. Below, at a boundry called the "thermocline," temperature and density of the water change rapidly; the thermocline forms a barrier separating the water above from the water below. No amount of wind on the surface will cause the bottom water to rise. It is isolated from contact with the air and soon depletes the oxygen that was dissolved in it before stratification (establishment of layers) occurred. Into this bottom portion falls a shower of plant and animal debris from the upper layers. These particles decompose and generate sulphides that are offensive in drinking water and poisonous to fish.

Twice during the year—once in spring and in fall—the entire body of water turns over and mixes. At other times the layers are normally stagnant, with the thermocline existing in the summer and disappearing in the winter. In either case, the water available for human consumption is limited to the upper layers.

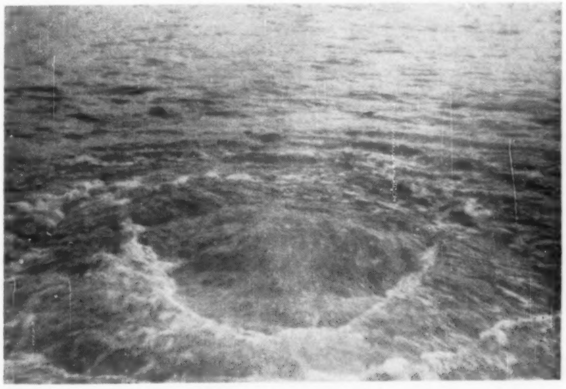
With use of the bubble gun, the usable potential of such reservoirs could be increased and many millions of gallons of water unfit for consumption could be made available. In an age when the need for water for domestic and industrial needs is constantly on the increase, this would be an important development.

In general, the procedure is the same as for ice prevention. It consists of keeping the total body of water in circulation and never allowing a thermocline barrier to form. The bubble gun brings up the dense water from below fast enough to insure that it mixes with the surface liquid. Calculations indicate the work needed to transfer water through the thermocline in a stratified lake is no more than 5 percent of the energy delivered by the bubble gun. The remaining 95 percent insures that the raised water mixes thoroughly with surface water.

At first it appears that keeping a whole reservoir in circulation would be a great project (just as preventing freezing seemed formidable). The facts show otherwise.

In 2 days ten bubble guns powered by a 5-hp compressor will raise to the surface a "block" of water more than a mile square by 1 foot deep. Thus in a summer session, between complete natural circulations 120 days apart, a mass of water 1 square mile by 60 feet deep is lifted and exposed to atmospheric oxygen. In short, the reservoir becomes a deep river, always circulating vertically, never stagnant. During the winter the same operation can maintain open water, and prevent the accumulation of sulphides that perhaps kill more fish than does shortage of oxygen.

The initial cost of a 10-gun installation is about $8000. The operating cost of a 5-hp compressor is slight. Figured for the summer season only, the cost would be about 30 cents for each million gallons of water rescued from pollution. There is, of course, nothing revolutionary in the idea of destratification, whether for ice prevention or for improvement of water supplies. Various methods of pushing water about have been and are being applied. The problem has been to do it positively, powerfully and economically. The bubble gun, combining compressed air power with the advantages of polyethylene materials, offers a solution that may significantly increase the value of waterways and reservoirs.



GUN WORKING The two pictures above show water being lifted to the surface at Lake Simcoe, Ont., during the tests there. The photograph as left was taken while the gun was delivering 2,500,000 gallons per day. Installed when the ice was already 12 inches thick (note ice beyond water's edge), the unit melted 200 tons of ice in 3 weeks. This created and maintained an open area of 8000 square feet. Very vigorous here, the action was modified later for better dispersal across the surface. In the right photograph, water flow is being directed in an 180-degree arc toward the camera. This arrangement is applied when the guns are placed along the sides of a channel. All water flows efficiently into the channel.

Welding Missile Sections

A SAVING WITH AIR POWER APPLICATION

MUCH has been said of the pneumatics industry as a whole and the constant help it gives all branches of engineering and technology. When the space age developed, it went to its aid too. It is not surprising, therefore, to find an air-operated device helping to make LOX and fuel tanks for Saturn.

The problem facing the engineers at Redstone Arsenal took the form of matching the crinkly aluminum edges that had to be welded together to make the tanks. The solution, as reported in *Missiles and Rockets* by Jay Holmes, was found by 38-year-old William J. Franklin, a mechanical engineer from Oklahoma. He has produced a pneumatic stainless steel circular backup bar that presses the huge cylindrical tank sections into position for accurate welding.

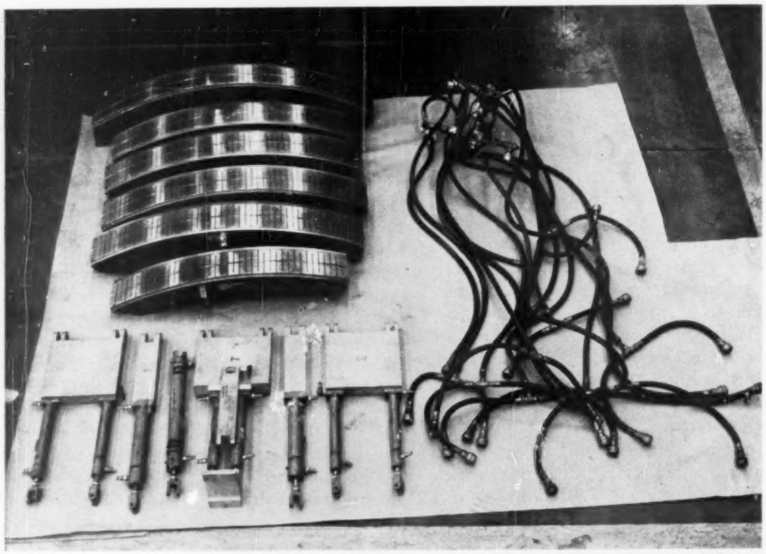
Saturn's tanks are of two sizes: 105 and 70 inches in diameter. The latter vary in wall thickness from 0.05 to 0.19 inch; the former, from 0.25 to 0.37 inch. These complications of size and thickness are compounded by the fact that any welding backup bar used must be removed through a 15-inch hole after the operation has been completed.

The illustration shows a collection of the components of Franklin's invention. Stainless steel bands are slipped over the outside of the cylindrical sections near the edges to be welded. The circular backup bar is assembled inside the tank sections. The outer ring of this bar is segmented stainless steel (see top of photograph). Inside the stainless steel are successive layers of high-temperature plastic and rubber.

When the edges are brought together, air is pumped into the rubber sections so that the circles expand and stretch the diameter of the skins by about 0.25 inch.

After welding, the bar is released, allowing the aluminum to contract to its original position, thereby relieving some of the tensile stress in the welded area. When the last section of the tank containing the front end is welded into place, one man remains inside long enough to disassemble the backup bar and pass it through the 15-inch opening.

The device can be controlled for different thicknesses of metal in the exterior skin. Franklin, who is the chief of the tool engineering section in the Fabrication Laboratory of ABMA's Development Operations Division, says that the bar provides the same reliable and uniform backup pressure throughout the entire 360 degrees of the weld, since the internal rubber bladder supplies equal pressure both radially and circumferentially.



Photo, Missiles and Rockets

BACKUP BAR COMPONENTS Shown here is an array of parts for what inventor Franklin calls the Serpentine Segmented Backup Bar. The pneumatic ring provides pressure to hold the thin aluminum skin of a Saturn tank to circular shape.

Adjusting Grinding Pressures

AUTOMATIC adjustment of grinding pressure across the width of a conveyor belt is achieved by compressed air in a grinder made by Mattison Machine Works, Rockford, Ill.

The grinder's purpose is to smooth honeycomb stock, sheet stock, motor laminations and various small flat parts. The actual grinding is done by an abrasive belt working above the conveyor belt. This grinding belt runs round four rollers arranged, in what appears in the side view, as a diamond shape. The long dimension of the "diamond," or parallelogram, lies horizontally. The belt is continually flexed by passing to the four rollers, thereby keeping clean, cool and free cutting. One roller aligns the belt, another drives it, the third applies grinding pressure, and the fourth is an idler.

The conveyor belt that brings work to the grinder travels over a table. At each corner of the table is a supporting air cylinder. When material to be smoothed is carried into the grinder, the air cylinders go to work. In some cases the workpiece is uneven. The air cylinders adjust to the difference in grinding pressure and allow the belt to conform closely to the surface of the uneven sheet.

The grinder is sometimes equipped with a single head. This type is used for reciprocal or single-pass work. It can also be supplied with multiple heads and a straight-through conveyor, for only one operation. Thickness tolerances are held to plus or minus 0.001 inch.

Due to the diamond-shaped design of the grinding belt, there is no wrapping or long arc of contact on the contact roll. This resulting flat grinding angle, plus the even pressure supplied by the air cylinders, means a higher quality of work.

Industrial Notes

TWO Torque Control Impactools, Size 5020TD and 5040TD, feature detachable Torsion Bars to increase the speed and accuracy of driving nuts, bolts and cap screws to a variety of precise torques. With these Impactools, it is not necessary to reset the tool for each torque, nor is it necessary to use a whole array of Impactools to deliver a needed variety of torques. To change the torque delivered by either of these Ingersoll-Rand tools, the operator simply snaps on a different, preset, Torsion Bar. Each of the tools is available with Heavy and Light Torsion Bars: the Light for the 5040TD may be set for torques from 20 to 50 foot-pounds; the Heavy Torsion Bar covers the range from 45 to 90 foot-pounds, giving a spread of 20 to 90 foot-pounds. Similarly, the bars for the 5020TD Impactool may be set for 6 to 17 foot-pounds and 10 to 30 foot-pounds.

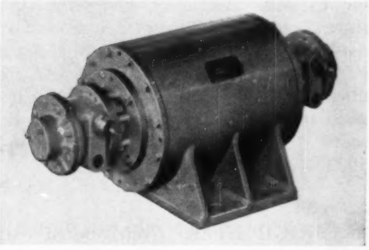
Both Impactools shut off automatically when the preset torque is reached. Production speed and quality are increased, as the operator no longer has to rely upon his judgment to determine when the fastener is run up tight. The torque mechanism is automatically reset for the next operation as soon as the tool's trigger is released. They can be set for fasteners with either right- or left-hand threads. A retainer allows the bars to be changed as easily as changing a socket, yet keeps them from falling off accidentally.

The Size 5020TD is 11 inches long, measured to the shoulder of the square driver, and weighs $4^3/_{16}$ pounds. The more powerful 5040TD is $12^7/_8$ inches long and weighs 7 pounds. A heavy bar is standard equipment with each Impactool; Light Torsion Bars are available as optional equipment. Further information is available in Form 5298. *Ingersoll-Rand Company,* 11 Broadway, New York 4, N. Y.

UNI-GRIP Auxiliary Vise Jaws, the invention of an Italian mechanic, convert machine vises instantly into universal holders that can grip and clamp angular, round and irregular shapes. The faces are a series of case-hardened steel wedges, with freedom of movement that resembles steel fingers. They automatically conform to irregular shapes when the vise is closed, clamping a steel ball, wedge shapes, vertical and horizontal pipe and rods, and the like. Workmen simply "put 'em on and take 'em off" the vise jaws. Free-swinging counter balances hold them in place without screws or clamps. So confident is Mid-American Import Company of this product, it says that Uni-Grips for 4-, 5-, and 6-inch vises are available for a free 10-day trial. *Mid-American Import Company, Inc.,* 1919 Champa Street, Denver 2, Colo.

A COMPREHENSIVE bulletin has been published under the title, *Armstrong Float Type Liquid Drainers.* It will certainly be of value to engineers confronted with problems requiring drainers for low, medium and very high pressure service. Included are tables and diagrams for compound-lever, single-lever and high-leverage models. Open- and solid-float drainers for pressures to 5500 psig are also discussed. The 12-page brochure concludes with information about inverted-bucket gas traps, which appear to be superior to ball-float traps. The reason is that oil rises to the top of the inverted traps and is discharged first, whereas in a ball-float drainer, water is discharged ahead of the oil, resulting in a body completely filled with oil, a condition that makes operation difficult at best. Copies of Form No. 400 are available without charge. *Armstrong Machine Works,* Three Rivers, Mich.

EQUIPPED with either pneumatic or hydraulic drives, the DVP-24,000 vibrator will develop 12 tons of unbalanced force at 3000 rpm, giving it a power-to-weight ratio that well exceeds other vibrators. Frequency may be steplessly controlled from 0 to 3000 vibrations per minute by regulating the flow of air or oil. The unbalanced force is generated by a lead-shot loading, which allows simple power adjustments by removing or adding shot to the eccentric weight. Used for the largest of chutes and



bunkers, the DVP-24,000 must be fastened securely to the heaviest of structural members to be effective. *Martin Engineering Company,* Neponset, Ill.

RIGID-LINE couplings, designed solely for use in permanent piping, are described in a 2-page bulletin that was recently published. The series is prepared for quick addition or removal of relief, flow control or check valves in permanent hydraulic or pneumatic installations. Couplings are offered with the usual Snap-Tite facility of quick-connect-disconnect, plus the added advantage that no flexible hose is necessary on either end of the coupling. Both installation and removal is possible without tools when the couplings are used in pairs. To disconnect, collars on the couplers are pulled back and the center section comes free. To connect, the sliding collars are pushed back, the section being installed moved back, and the collars released. The bulletin lists two sizes available in three finishes and three metals. The Rigid-Line Series also is available with a choice of four end fittings with any of eight seals. *Snap-Tite, Inc.,* Union City, Pa.

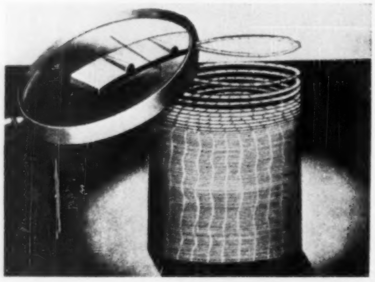
HIGH-PRESSURE pipe fittings, featuring a Parkerized rust-proof finish, in-

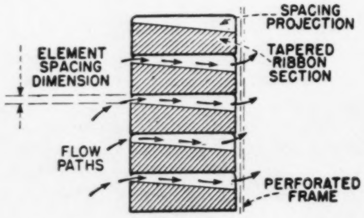
clude a complete selection of forged steel screw and socket welding fittings to meet 2000-, 3000-, 4000-, and 6000-psig pressure specifications. (Included are 45- and 90-

degree elbows, tees, cross and lateral fittings, couplings, reducers, and caps to fit pipe sizes from $^1/_8$ to 4 inches.) It is said that the Parkerized finish imparts a phosphate coating to steel, protecting the exterior and interior against rust scale, even when fittings are stored or used under very humid conditions. Parkerizing simplifies handling and reduces maintenance, since there is no need to coat fittings with grease, oil or paint. *Clayton Mark & Company,* 1900 Dempster Street, Evanston, Ill.

REFRIGIFILTER (refrigerated air dryer) F-30 has been designed to protect medium capacity pneumatic systems from destructive moisture, oil vapors and other contaminants. It has a rated capacity of 30 scfm and combines the functions of a refrigerated condenser, separator, filter and trap. Product Bulletin No. 9100, available from the manufacturer, includes complete specifications, capacity charts and installation procedures. *Hankison Corporation,* College and Pike, Canonsburg, Pa.

LIQUID GASES, such as nitrogen, are normally difficult to filter because of the low temperatures and thermal shock conditions that are involved. Yet, Purolator Products, Inc., has developed a filter that withstands high pressures and flows without requiring excessive down time for cleaning. The unit can take an operating pressure of 150 psig, although actual operating pressures are maintained at about 75 psig. It has been in operation since early fall, 1960, and can process ten tank car loads of liquid nitrogen at 10 microns or less before a differential pressure of 25 psig necessitates cleaning. The operating period is about 30 times that of a previous filter which had failed to perform this function, according to company reports.



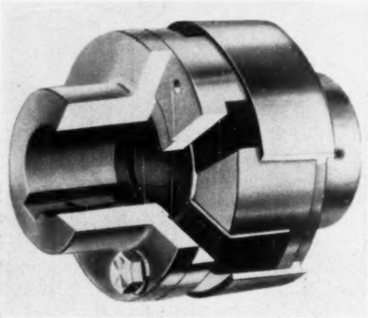


METAL-EDGE FILTER ELEMENT
Cross-Section View of Trapezoidal Ribbon Design and Slot Structure

Since this original filter, a similar one has been devised for operating pressures of approximately 10,000 psig and flows of 120,000 scfh. In this second unit, the filter consists of a metallic edge type filter coated with approximately 0.010 to 0.015 inch of porous metal. This design was chosen because of its record of dependability and efficiency in similar applications. The element is capable of withstanding differential pressures in excess of 2500 psig. Such metallic edge filters consist of a trapezoidally formed ribbon wound in a cylindrical shape with precision-formed risers on the ribbon which are then resistance-welded to the adjacent smooth coil. These risers are carefully engineered to hold the adjacent wires apart and form a support for the thin sections of porous metal medium attached by a metallurgical bond (*see illustration*). In addition to the high strength obtained with this special design, the filter element is further reinforced on its interior which allows it to withstand all necessary differential pressures. *Purolator Products, Inc.,* Rahway, N. J.

LUNKENHEIMER'S new ball valves are described in a 2-page, 2-color catalog sheet, Circular 611. Detailing the operation of the valves, the bulletin also shows cutaway views, ratings and specific design features and dimensions. In addition there are reports on applications and advantages. *Lunkenheimer Company,* Cincinnati 14, Ohio.

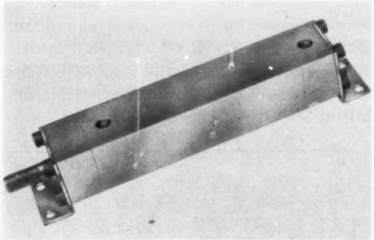
STANDARD-DUTY type CQ and heavy-duty type HQ flexible couplings that incorporate one set of jaws in removable ring form, permitting both independent rotation or radial removal of connected machinery, are especially advantageous on gasoline, steam or diesel engine applications where the driven machinery must be disconnected to set or time the engine. The couplings use individual free-floating load cushions of material suited to the particular application. Since the full load is transmitted



through cushion compression only, there is no wear on the metal jaws, according to a company report. Lubrication is never required. Pulling a removable

jaw ring outward provides enough clearance for independent rotation of either end of the coupling. Simply by reversing a set of cap screws from one body to the other, connected machinery can be removed radially without disturbing power transmitting elements of the coupling. Type CQ couplings are available with maximum bores from $1^3/_8$ to $5^1/_2$ inches. They range from $1^3/_4$ to $8^1/_2$ inches, horsepowers from 7.77 to 810 at 100 rpm. *Lovejoy Flexible Coupling Company,* 4865 W. Lake Street, Chicago 44, Ill.

SQUARE air and hydraulic cylinders have been introduced by Galland-Henning Nopak Division. Perfectly square on the outside, with each of their four sides flush and flat, they have myriads of mounting possibilities; compact, small in size and light in weight, they fill many application requirements that conventional cylinders cannot meet, and it is possible to drill and tap along the length of the barrel for these mounting requisites. The cylinder tube or barrel is



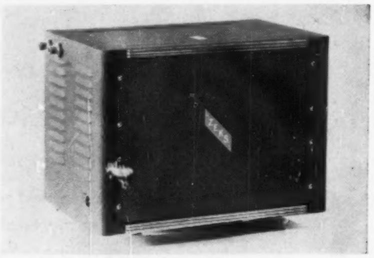
seamless extruded aluminum drawn to a smooth micro-finish. Cylinder heads and head plates are precision pressure-cast aluminum. There are no tie rods as the square head is bolted directly to the matching all-square aluminum barrel, resulting in a strong, rugged lightweight cylinder. A selection of interchangeable attachments is available for foot, flange,

"Mr. Benson, the repair man from the intercom company is here."

clevis and trunnion mountings, and many combinations. Piston rods are stainless steel. Piston seals and rod seals are of V-block construction, noted for its long service life and minimum breakaway friction. A built-in rod wiper is standard in each bore, and is interchangeable with the rod seal. At present, $^3/_4$-, 1-, $1^1/_2$-, 2-, and 3-inch diameter double-acting square barrel (Class 7) cylinders are in production. *Galland-Henning Nopak Division,* 2753 S. Thirty-First Street, Milwaukee 46, Wis.

DIAPHRAGM control valves are the subject of Bulletin 800, a publication offered by Warren Engineering Company. Design, application and operation are discussed. Some of the units contained in the 2 dozen pages of this 2-color brochure include 3-way valves: double- or single-seated bellows-operated pressure-regulating valves; miniature models; and hydraulically balanced control mechanisms. *Warren Engineering Company,* Main Street, Broadway, N. J.

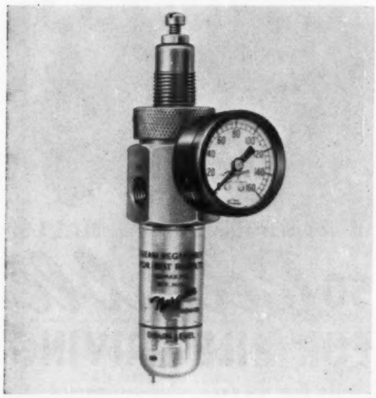
MODEL 101AD Air Dryer consists of a small refrigeration compressor with a thermal-mass-type heat exchanger—both are housed in a $22 \times 16 \times 14^3/_4$-inch deep-louvered cabinet for easy wall mounting. This self-contained refrigerated compressed air dryer uses a heat exchanger that has developed through several years of research and testing. Its refrigerant and air coils are surrounded by a heat-conductive material of con-



siderable mass. Because of this mass, a substantial flow of compressed air through the exchanger results in only a small temperature rise in the exchanger media. Thus the air is cooled to a nearly constant temperature regardless of fluctuating air volumes passing through the exchanger. The unit is said to be capable of dehumidifying 100-psig-pressure air to $-12°$ F dew point (atmospheric) at a rated 10 cfm. Temperature of the exchanger is controlled with a thermal switch, situated in a protective well in the thermal media. This controller cycles the refrigeration compressor as required to maintain an exchanger temperature slightly above freezing. Also in the exchanger is a centrifuge-filter unit designed to prevent "blow-by" of condensed moisture into compressed air lines. The center core of the exchanger is fully insulated to minimize the ambient load upon the exchanger and to keep atmospheric condensation within the cabinet nominal. Information about this dryer is available from the manufacturer. *Zeks Industries, Inc.,* P.O. Box 435, Haverford, Pa.

IN LINE with the contemporary trend towards compactness, C. A. Norgren has developed a line of compact pneumatic products. The series consists of high-performance manual- and automatic-drain compressed air filters; pressure regulators; diaphragm-type relief valves; and compact Micro-Fog lubricators. Any combination of these units is available. Regulators and relief valves are used with air, water, oil and similar fluids. All units are made for $^1/_8$-inch pipe size (with regulators being also made for $^1/_4$-inch pipe). A small combined filter-regulator is a feature product. It removes foreign liquids and solids from compressed air and controls line pressure. Three compact units—filter, pressure regulator and Micro-Fog lubricator—make up a combination that automatically injects a continuous fog of

extremely fine oil particles into the air line, providing lubrication for air-oper-



ated devices or for machine bearings, even though the entire unit is not much larger than a man's hand. Catalog NA-3, which describes these new "compacts," is available upon request. *C. A. Norgren Company,* 3400 S. Elati Street, Englewood, Colo.

PIPE LINE strainers manufactured by Air-Maze Corporation are described in a comprehensive 2-page data sheet that lists specifications for the company's complete line. Engineered to fit into air, lube oil, or hydraulic pipe lines, these filters are designed to remove such contaminants as pipe scale, core sand, metal chips or construction dirt that may exist after initial installation of equipment. Easily installed, the strainer units are merely inserted in lines at any existing flanged joint. A special flanged

"I would delegate more of the work to people under me . . . but there isn't any one."

housing is also available for use when original flanges are not conveniently located. Air-Maze recommends installation of the strainers as close to the machine as possible. All engineers who are interested in extending their tool and machinery dollars may obtain copies of this literature directly from the company. *Air-Maze Corporation,* 25000 Miles Road, Cleveland 28, Ohio.

Books . . .

Research as a Science—Zetetics (published by University of Illinois, Office of Publications, 114 Civil Engineering Hall, Urbana, Ill.) was written by Prof. Joseph T. Tykociner and is one of the more challenging paperback books on the market today. "Research is a cultural activity which embraces all problems related to the preservation and development of mankind." From this starting point, Professor Tykociner, Research Professor Emeritus of Electrical Engineering, has presented a proposal for a new term, zetetics—the science of research—and has organized much of the present knowledge of research as a science, whatever its subject matter. His detailed proposal and basic outline are presented in this volume, with emphasis on the fact that the science of research is not concerned with the nature or administrative organization for conducting research. His aim is to establish a basis for the collection and systematization of all information about research itself, including the creative process. That is the knowledge that leads to discoveries, inventions and the solution of human problems.

The present volume was copyrighted in 1959, and the first edition is in its second printing. Two additional volumes are contemplated: the first will include zetetic tables; the second, the treatment of zetetics in relation to social development. The present two parts are the principles and aims, and an inventory of arts and sciences. Both are treated in a unique manner. 205 pages. Cost $2.

"I was in there 20 minutes before I found out it was the wrong meeting!"

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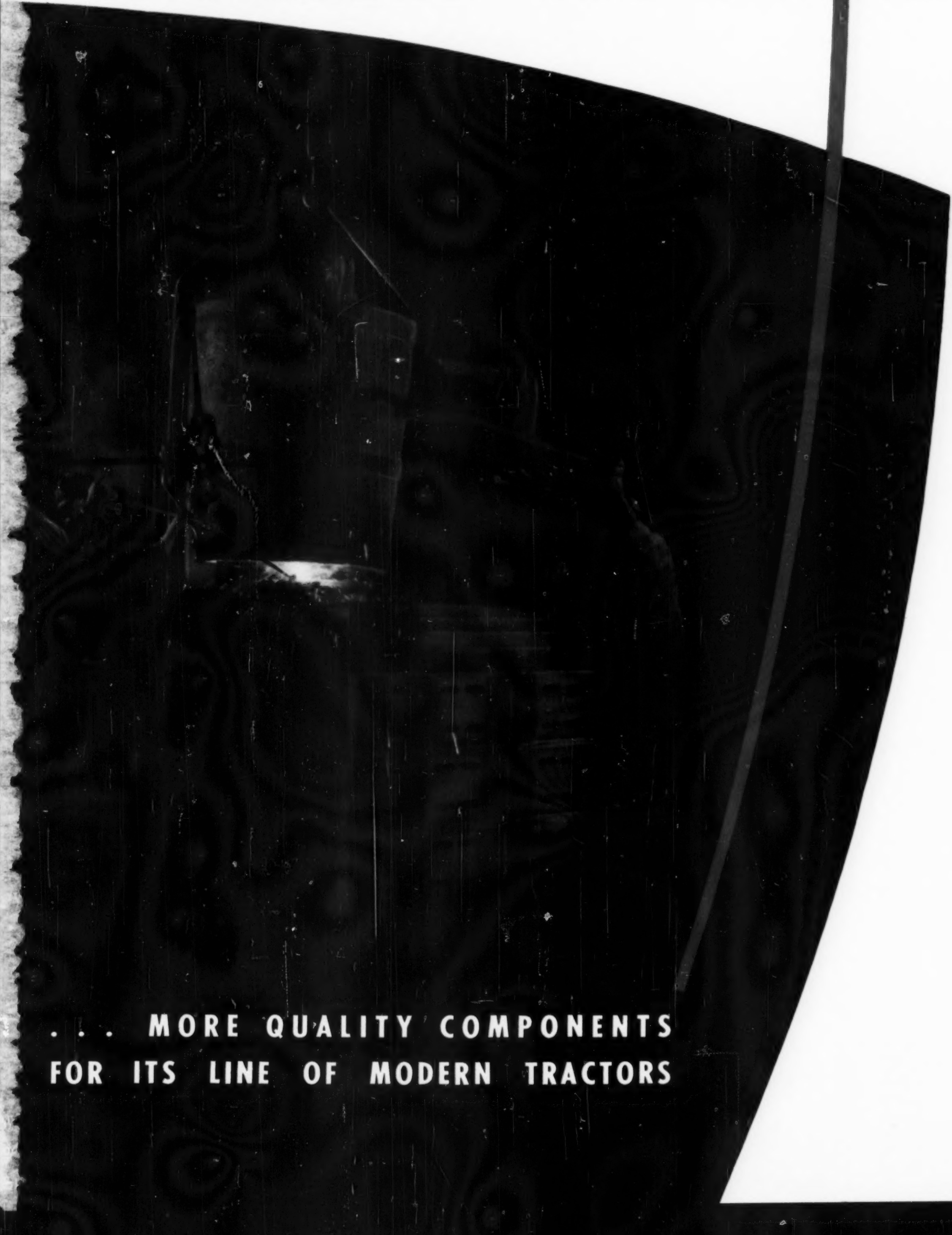

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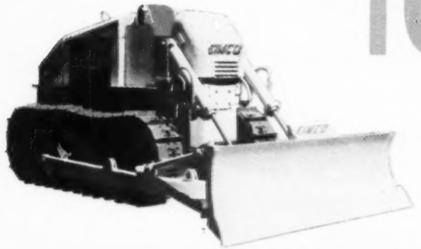

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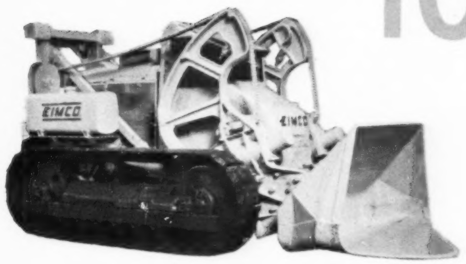

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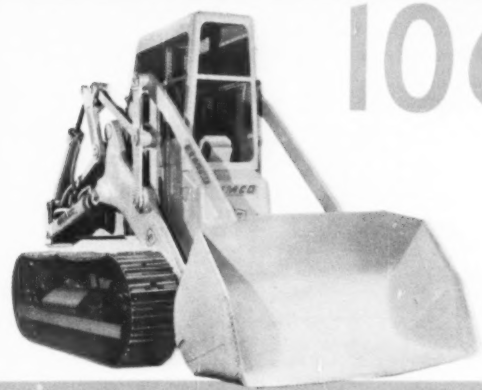

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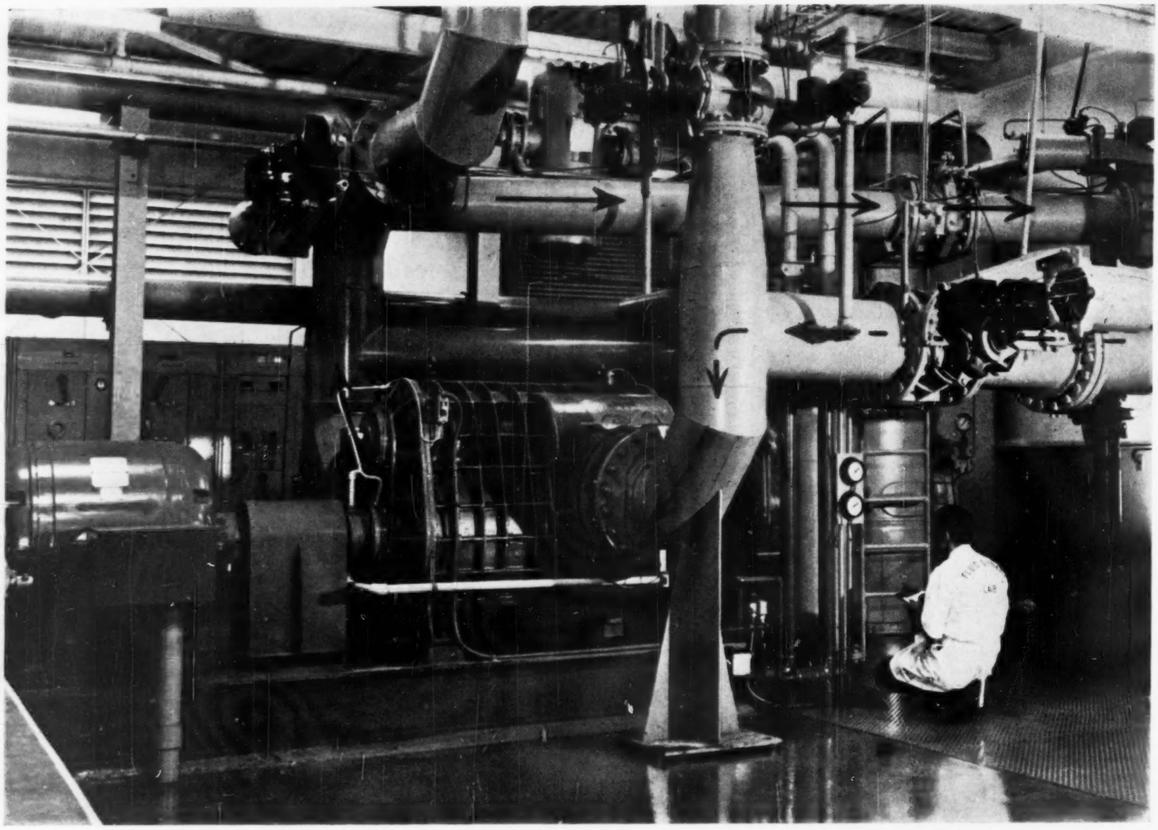

PRESSURE or VACUUM

The Ingersoll-Rand *Axi-compressor* provides both in a single, compact, versatile unit

USED for flight simulation at a large aircraft research center, the Ingersoll-Rand Axi-compressor shown above does double duty, serving either as a compressor or an exhauster. By switching of intake and discharge valves, it can provide up to 12,250 cfm of wind-tunnel air at 5 psig, or pull vacuums of up to 24″ Hg at correspondingly high capacity.

The Axi-compressor is a positive displacement, axial-flow machine which operates by the action of two intermeshing helical rotors turning at high speed. The rotors do not touch each other or the sides of the casing—hence there is no mechanical wear and no lubrication is needed, providing a smooth flow of *oil-free* air or gas. More compact than other units of equivalent pressure and capacity, it saves both floor space and head room and can often be installed where no other compressor or vacuum pump would fit.

Type L Axi-compressors are available in 29 basic sizes, with capacities from 100 to 12,000 cfm and pressures to 15 psig or vacuums to 24″ Hg. Ask your Ingersoll-Rand engineer for complete information, or send for a copy of Bulletin 11,003.

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THE WORLD'S MOST COMPREHENSIVE COMPRESSOR EXPERIENCE